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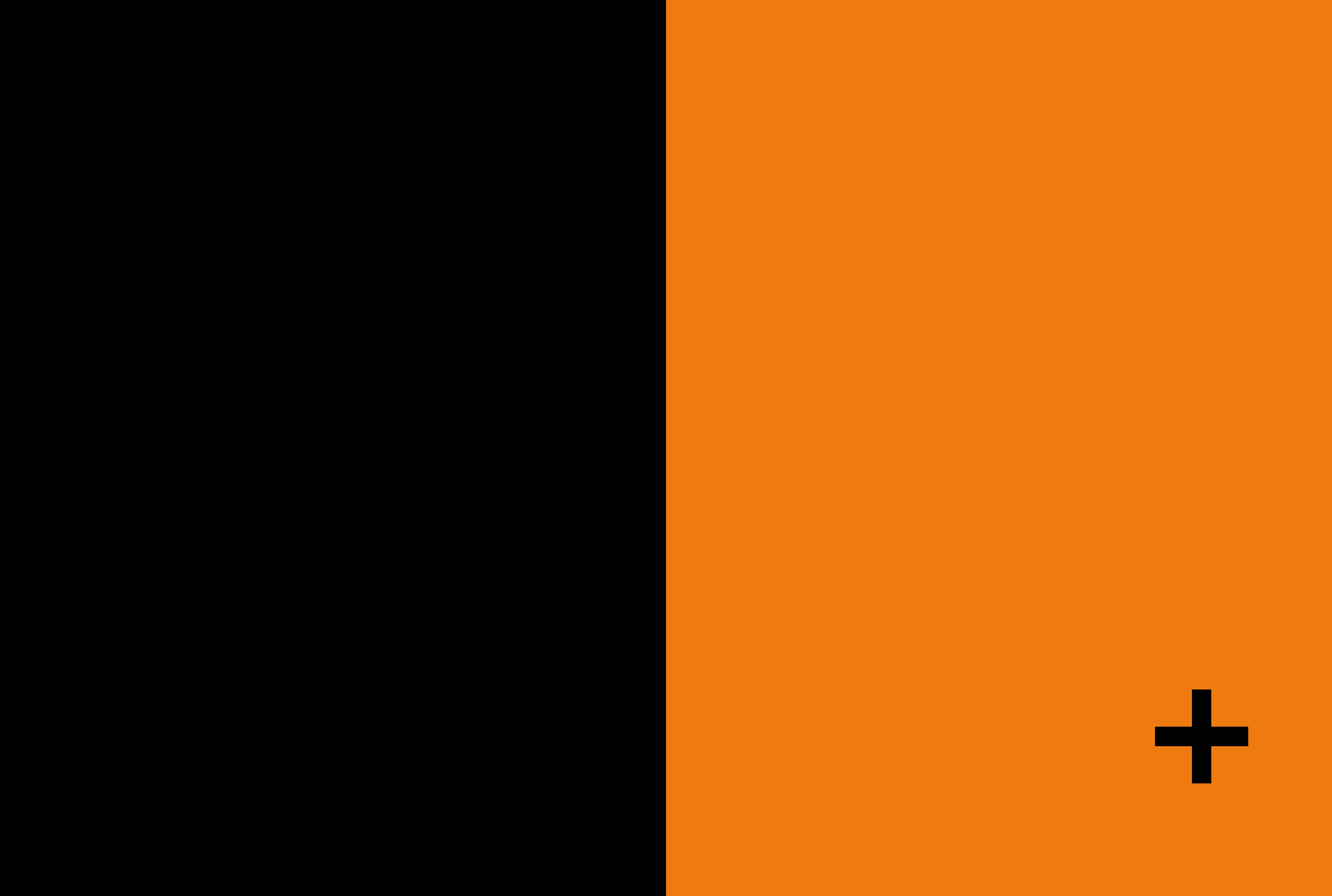
SCIENCE

GALLERY



HUMAN+

THE FUTURE OF OUR SPECIES



WHAT IS HUMAN+?

What do we mean when we speak about human enhancement? NYU professor Wafaa Bilal recently had a video camera implanted on a titanium base in the back of his skull. Leaving wires dangling awkwardly along his neck, the camera sent images to a remote server every 60 seconds. Students’ concerns over their privacy, faced with a teacher who for once really did have eyes in the back of his head, forced Bilal to wear a lens-cap while teaching, somewhat defeating the point. A few months later an infection forced Bilal to remove the camera, and simply wear it around his neck, but he remains keen to have it back in his skull as soon as possible. Why? What is the difference, you might wonder, between a camera strapped to someone’s neck and the same camera attached to the skull with a titanium plate? To Bilal, it is all about a demonstration of ‘commitment’, making the painful surgery and risk of infection worthwhile. Bilal’s messy piece of DIY illustrates some of the challenges around popular perceptions of human enhancement.

Australian artist Stelarc has grown a third ear in a lab and inserted it into his left forearm. Nina Sellars’ arresting photographs of the process are on view in **HUMAN+**. Stelarc hopes to insert a bluetooth microphone into the ear so people all over the world can listen into his conversations over the internet, though the completion of this aspect of the project has so far been delayed by infection. For a small fee, body artist Steve Haworth will provide you with small magnets implanted in your finger tips so you can ‘feel’ the presence of magnetic fields.

Cybernetics Prof Kevin Warwick hit headlines when he had an RFID chip implanted in his arm to allow him to open and close doors, prior to more sophisticated experiments on direct neural/electronic interfaces. Warwick caused even more controversy when he reportedly suggested that an 11-year-old girl should be ‘chipped’ with a tracking device in the wake of the Soham murders, in a similar manner to pet dogs and cats.

These stories have perennial fascination for the media, perhaps less for the ‘superpowers’ of their protagonists, which could arguably be accomplished through less radical interventions, and more for their disturbing transgressions of the boundaries of the human body. We seem to fantasise endlessly about cyborgs – ROBOCOP-style human-machine hybrids—but many of the dimensions of human enhancement are far more subtle and pervasive. Humans have always been augmenting their senses, physical powers and cognitive abilities through ingenious tools and technologies. The Hubble telescope, functional Magnetic Resonance Imaging and Atomic Force Microscopes can be viewed as extensions of the senses, just as our new-found ability to gather ‘swarm intelligence’ about developments in Libya or Japan instantaneously through social media is an extension of the campfire conversations of Neolithic man. We are continually developing new ways to see the invisible, to share knowledge and conduct our social lives remotely. In attempting to defeat ageing processes, cosmetic surgery promises to extend youthful appearance as Viagra promises to extend our sexual activity into old age.

NEEDS

Why shouldn't we consider contact lenses, mobile phones, watches and bicycles as human enhancements? Going back further still, the invention of writing itself, as recounted by Plato in a famous passage in the Phaedrus, was an enhancement that simultaneously extended and impaired human memory, by providing an externalised written record but diminishing people's ability to memorise by removing the necessity of learning by heart. Plato's warning about the consequences of writing for human memory is an important lesson for contemporary discussions around human enhancement through technology. New technologies, from mechanical looms to automatic cars, are always double-edged, extending certain powers while eroding traditional skills.

So is there anything special about enhancement of the human body that goes significantly beyond mere tool use? Is there any hope for our cyborg brethren to become a regular feature in our supermarkets, yoga classes and crèches? Any compelling reason to implant chips in our brains and limbs through surgery and risk all the messy hardware updates and unpleasant maintenance issues that come along for the ride? Can we still expect superpowers for our physical bodies, and look forward to the ability to see ultraviolet light like bees or to have canine powers of hearing and smell? Or does the future instead lie in 'downloading our brains' to computers, effectively trading in our fragile flesh for more durable hardware, as imagined in Ray Kurzweil's vision of the 'singularity', a neo-Cartesian negation of the body and all its fluids and leaky orifices? Stelarc's Prosthetic Head, a simulated intelligence rather than a downloaded brain, is an experiment in what it might be like to live in Kurzweil's world, a Turing Test on humans.

Interestingly it is those individuals traditionally classified as 'disabled' who are currently at the vanguard of human enhancement technologies. From cochlear implants and artificial hearts to neuro-prosthetics, these 'early adopters' of assistive technologies are pioneers inhabiting an increasingly narrow boundary between a perceived 'lack' and an unfair advantage in relation to the general population. Consider South African athlete Oscar Pistorius, born with the congenital absence of the fibula from both legs, with his prosthetic blade 'cheetah' legs leading to his near miss from participation in the Beijing Olympics. MIT researcher Hugh Herr has suggested that we may soon require an 'Extra Special Olympics' to accommodate athletes with prosthetics and other

enhancements. Perhaps in this context 'non-enhanced' athletes would be regarded with something of the polite nostalgia with which we now view "real tennis" with its quaint long trousers and wooden racquets. Or consider athlete and model Aimee Mullins who has redefined our notions of female beauty, with twelve sets of prosthetic legs for different occasions and her prominent appearance in Matthew Barney's celebrated Cremaster exhibition at the Guggenheim Museum in New York.

Beyond the glamour of the Guggenheim and the Olympics, a key driver in the development of new prosthetic and robotic technologies is the military, fuelled in the US particularly by demand from increasing numbers of veteran amputees from the Iraq and Afghanistan wars. Much of the media discussion around the Defense Advanced Research Projects Agency (DARPA) and human enhancement is focussed on notions of the 'future soldier', the cyborg in combat, but the thrust of much of DARPA's work in this area appears to be in allowing war veterans who are amputees to live relatively normal lives. The DARPA Revolutionising Prosthetics programme had aimed to have fully functional neural prosthetics controlled by brain-computer interface by the end of 2010, but ran into serious problems in integrating human neural pathways with control technologies. DARPA believe that brain implants—"implanted cortical microelectrodes"—should be the basis of future control over prosthetics, raising the familiar spectres of infection risk, and ease of maintenance and replacement.

Kazuo Ishiguro's novel Never Let Me Go, recently made into a major film directed by Mark Romanek, imagines a society where clones are bred and housed in a traditional English boarding school to grow replacement organs for their 'originals' to permit the extension of life beyond organ failure. Ishiguro's novel and the film it inspired are a poignant alert to the potential societal costs of human enhancement and life extension. New reproductive technologies and personalised genetic data provided by companies such as 23andMe are already requiring a dramatic reconfiguration of our conceptions of the family and courtship strategies. Personalised genetic screening, Gattaca style, could soon become intertwined with everything from bank loans and online dating to health insurance premiums, and we are excited to include in HUMAN+ a live experiment on the D4 Dopamine receptor gene which allegedly codes for 'high risk behaviour' with the help of Dr Aoife McLysaght, Dr Ross McManus, Prof Fiona Newell, Prof Hugh Garavan, Prof Luke O'Neill and Prof Ken Wolfe.

The Methuselah Foundation has recently launched the New Organ Prize, "awarding as much as \$10,000,000 to develop and transplant a new organ by the year 2020". The goal of the prize is to stimulate new techniques to grow and replace organs (kidney, liver, heart, lung, pancreas) from a patient's own cells. The same foundation also offers the M-Prize, awarded for the world record for the oldest-ever mouse. This ancient rodent will, it is hoped, lead to new ways to extend human life.

The quest to extend life and youth has become a central focus of the Transhumanist movement, championed by prominent figures like Aubrey de Grey. Life-extension through medical technologies, reduction in violence and improved diet is already a reality in the world. Even in the last forty years in Ireland our life expectancy has increased by a decade. The cryonics industry is fuelled by the enticing possibility of resurrecting the body through future technology, with companies offering to preserve your cryonically frozen head or full body through taking over your life insurance policy. Juan Enriquez of Biotechonomy is a strong advocate of the potential of stem-cell technologies, pointing out that we can already create replacement molars, bladders, ears and even tracheae in vitro.

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In tones disturbingly reminiscent of Nietzsche's announcement of the Übermensch, Enriquez talks about the coming rise of Homo evolutis. Unlike Homo sapiens, Homo evolutis is characterised by taking direct and deliberate control of our biological destiny. Eduardo Kac's Edunia provides a contrary riff on human biological potential, combining the artist's DNA with that of a Petunia plant to create a new human-plant hybrid that extends the artist's presence and confronts us with the possibility of very different genetic futures.

A problem with the utopian perspectives of Enriquez and the Transhumanists towards the indefinite extension of life through regenerative medicine is that they tend to ignore on the one hand the social and emotional consequences of extreme longevity, and on the other hand to consider self-directed human evolution in splendid isolation from our changing ecological and environmental contexts. Some of the works exhibited in HUMAN+ highlight the issues inherent in life-extension. Euthanasia Coaster by Julijonas Urbonas is designed to deal with the ultimate boredom of longevity by allowing people to leave life in a euphoric state through an amusement park ride designed to kill.

Other works explore the fact that we may not be the ones who actually get to decide what new functions future humans need to perform. Laura Allcorn's Human Pollination Project demonstrates how much we rely on the ecosystem services provided by honeybees, and asks us to imagine a future where human behaviour has to be modified to provide pollination services due to the dramatic decline in bee populations. Zbigniew Oksiuta's Personal Biosphere is a meditation on the requirements for life and an externalised body providing our living requirements. Dunne and Raby's Foragers project considers a future society where food is scarce due to overpopulation and people need to create externalised stomachs so they can digest pond algae. John Isaac's disturbing sculpture If Not Now Then When offers a very different dystopian vision of the future of the human species, almost a Homo devolutis.

HUMAN+ is a combination of a sweet shop and a pharmacy, an Alice-in-Wonderland world of pills, promises and prosthetics. These works are ultimately about the fragile and contingent nature of human futures, they invite you to ponder the different dimensions, costs and unintended consequences of enhancement.

I am hugely grateful to my fellow curators and advisors for all their help and enthusiasm in creating this exhibition, to the Wellcome Trust for their support and encouragement, to Trinity College Dublin School of Medicine and the Trinity Long Room Hub for their support and advice and to all of our other supporters and sponsors, with a special word of thanks to researcher and designer Cathrine Kramer for helping draw together the cat's cradle of threads that link the ideas, artworks and experiments in the exhibition. Thank you, as always, to the Science Gallery team.

HUMAN+ tests our boundaries—boundaries of the body, boundaries of the species, boundaries of what is socially and ethically acceptable. Should we enhance ourselves, or seek to modify our descendants? Are we approaching a singularity of human-machine hybridization or de-skilling ourselves through our ever-increasing reliance on technological extensions of the body? Is extended human longevity a wonderful aspiration or a dire prospect for the planet? The ultimate decision is yours. Which enhancement will you choose?

CURATOR INTERVIEWS

SCIENCE GALLERY (SG) INTERVIEWED SCIENTISTS, ARTISTS AND CURATORS ABOUT THEIR VISIONS FOR THE FUTURE OF OUR SPECIES

PROF RICHARD REILLY—
PROFESSOR OF NEURAL ENGINEERING AT TCD FOCUSING ON UNDERSTANDING AND MODELING THE PHYSIOLOGICAL BASIS FOR HOW WE INTEGRATE AND PROCESS SENSORY INFORMATION FROM MULTIPLE SOURCES, USING LEADING-EDGE TECHNOLOGIES, CONSIDERS THE FUTURE CHALLENGES IN NEURAL ENGINEERING

SG: Are we moving into a future where rather than focusing on rehabilitating those with sensory loss or permanent disabilities, healthy individuals will elect to have invasive surgery to ‘enhance’ themselves or their senses?
RR: While there have been great advances in the design, control and interfacing of electronic devices that exist inside the body, as exemplified by cochlear and retinal implants, our level of understanding of how our sensory information is acquired, relayed and processed in distinct areas of the brain is still poor. There remain a number of unsolved technical challenges that need to be overcome to really make such implants function to a level approaching that of the biological originals. Once we get to this level then these sensory implants may become as commonplace as orthopaedic hip implants are for those with mobility problems.

As regards sensory enhancement as popularised in science fiction, this is not possible with the strategy employed by current designs in cochlear and retinal implants, which focus on overcoming the damaged input sensory cells in the cochlear or in the retina. One would have to interface directly at higher sensory processing levels in the brain to impact augmentation. However, given our poor understanding of the complex interaction of different brain areas to process sensory information, sensory augmentation is not possible.

However, one method of sensory augmentation does exist. An important domain of investigation is sensory supplementation, whereby the characteristics of one sense modality are supplemented by sensory stimulation in another modality. This is more sensory substitution than sensory augmentation, but there have been interesting results presented by a number of research groups. These include replacing aspects of visual images captured by a camera with sensory stimulation of the tactile receptors on the tongue to provide a mobility device for those with visual impairments.

CURATOR INTERVIEW

SG: What are the limitations, challenges and potentials in your field?
RR: There are three main challenges I foresee in neural engineering, which will influence the impact that the discipline can make in promoting health and wellbeing for the twenty-first century as our lifespan increases beyond 100 years. Firstly, there is a need to develop methods for real-time functional brain imaging. A second major challenge is to improve the ability to decode brain signals across all levels of complexity, i.e. from single neuron to the whole brain. This will require development of new methods to understand how synaptic activity is integrated into whole brain function. Thirdly, implanting smart devices inside the brain requires fundamental problems to be addressed. These include the development of methods to functionally interface to neural tissue giving real time information. Can we create a dashboard to remotely observe how an individual's active implants, for example a deep brain stimulator or a cardiac pacemaker are functioning on a millisecond by millisecond level?

SG: Do you think that there is significant potential for disabled people to become the early adopters of human enhancements?
RR: Those with disabilities are just differently abled. Technology has an important role to play in allowing these abilities to be maximised. As a result these individuals tend to be on the frontline with regard to testing of new devices, but are increasingly becoming more involved in the specification and design of diagnostic aids and devices. These include augmentative and alternative communication systems and mobility devices. User centred design is a new approach within the discipline of universal design, which is best practice for product design.

CURATOR INTERVIEW

SG: Is human evolution over?

AMcL: I'd quickly give a straight answer of “no”. Some people have several children, and others have fewer or none—this simple fact means that the constitution of the population is changing from generation to generation. This is evolution. However, when you ask this question, the ordinary person is probably thinking of change in a particular direction, or even gradual accumulation of adaptations or improvements. This is the kind of change that is associated with natural selection. We might suspect that we are interfering with the course of natural selection through medical interventions, but it's unlikely to have any effect on the generations that follow—the interventions are too sporadic and the underlying causes so diverse in origins. So, we are still evolving through a combination of stochastic changes and responses to our environment, but it's difficult, if not impossible, to say what the future holds.

SG: You are one of the scientists behind the Free Will experiment in HUMAN+, looking at the Dopamine receptor D4 gene which has been linked to high risk behaviour. Do you think our personality is hard-wired in our genetics?

AMcL: Many aspects of our personality have a genetic component. We know this from looking at identical and non-identical twins—both sets of twins share their environment from the moment of conception and through family life, but only identical twins share all their genes. Any traits that are down to environmental or cultural factors should be equally similar between the two sets of twins. However, traits which are influenced by our genes will show a greater concordance between identical twins, who share all their genes, than between non-identical twins who share many, but not all genes. Twin studies have shown that there is a genetic component to happiness, artistic creativity, sociability, impulsivity, drug use and other personality traits, however, none of them could be truly considered to be “hard-wired” because they provide no more than a tendency which may or may not be realised depending on many different factors.

DR AOIFE McLYSAGHT—
TRINITY COLLEGE DUBLIN
GENETICIST CONSIDERS OUR
GENES AND IF WE ARE STILL
EVOLVING

SG: Is there a possibility that a new species of human will evolve?

AMcL: We are constantly changing. If you met an early *Homo sapiens* from 200,000 years ago there's a good chance you wouldn't recognise them as a member of the same species. If you could travel forward in time 200,000 years you would probably look as strange to modern humans as ancient humans would to us. In that sense, you might even say we're not all one species. If you're thinking instead of a H.G. Wells Time Machine scenario where there are two co-existing species of human, then this is utterly unrealistic. For this to happen, two groups would have to be completely isolated, as if on different planets, with no Montague and Capulet couples causing gene flow.

SG: Are we facing a “gene patenting” future where our specific genetic make up will one day be owned by a multi-national company?

AMcL: This is primarily a legal issue. Done well, patent law could provide an incentive for the development of new classes of pharmaceuticals and gene therapies. However, inappropriate, and perhaps overzealous, patenting of genes could make these potential therapies inaccessible or prohibitively expensive. As it stands the law seems to reject “catch-all” speculative patents on genes, and only allows patents where some inventiveness can be shown. This should mean that companies can recoup their considerable expenses in developing a new therapy, but not jealously guard all uses of a given gene thus preventing the development of alternative therapies.

DR RACHEL ARMSTRONG—
SCIFI AUTHOR, MEDICAL DOCTOR, INTERDISCIPLINARY
COLLABORATOR AND TED SENIOR FELLOW CONSIDERS
IMMORTALITY AND THE HUMAN BODY AS AN ARTISTIC CANVAS

CURATOR INTERVIEW

SG: Can we live forever?

RA: The prospect of ‘living’ forever is a human aspiration that is common to all cultures and historically the dominant existence paradigms were based in a religious understanding of the world and therefore the prospect of immortality was possible through deification. Today we can already live for ‘ever’ through exemplary feats and acts of humanity in our collective conscious through the vehicle of ‘fame’, but physical immortality is still elusive. As science and technology now hold the mantle of cultural truth (rather than religion) this ancient quest is now examined as scientific experiment leading to new practices such as cryonics and new ways of thinking about the process of human ageing in regenerative medicine.

SG: And if it is possible would we actually want to?

RA: Yes, of course we would want to live forever but with conditions attached to guarantee a certain quality of existence. Living forever as a memory is something that most of us aspire to in some way, to be remembered by those that love us. The physical accomplishment of living in a body forever is more complex as we fear the ‘unnatural’ condition of this prospect and the negative consequences, which are voiced in the cautionary tales of those who dare to seek this god-like status.

SG: But, where would all the people go? Is the world not already full?

RA: No, the world is not ‘full’ the issue is about the fair distribution of resources and how much time, money and commitment we are willing to give to seriously addressing fundamental inequalities across the globe. We need to think about how we can be more effective and environmentally responsible in our activities but there is plenty of ‘room’ on this planet for everyone.

SG: You have collaborated with a range of international artists who have engaged with the technologies of extreme body modification including Stelarc and Orlan. For artists that work with the human body—where does the human and the artwork begin and end?

RA: For performance artists who work with their body ‘as their canvas’ there is no physical separation between the artwork and their ‘natural’ anatomy such as in the case of Orlan. However, profound philosophical questions do arise regarding cognitive identity and ‘split’ personalities where artists need to choose when and how they ‘perform’ their artwork, which is most elegantly expressed in the work of Stelarc who offers up his anatomy for its manipulation by machines, machine consciousness and internet audiences such as, in his performance ‘Ping Body’.

SG: Finally in HUMAN+ we examine a number of dreams and nightmares of human enhancement, what does the ideal enhanced human look like or does it even exist?

RA: All ideals are cultural consensuses. I imagine the future human being is outwardly similar in appearance to people today but with better quality and longer lives. What will differentiate the future human to that of contemporary humans is their connectedness with nature, rather than their current isolation from it. This realignment of human activity and living on the environment will be facilitated by the development of living technologies that will not be machines as we classically understand but which will possess qualities such as movement, sensitivity and environmental responsiveness that will be seamlessly integrated into our lives possessing qualities which we already recognise in our gardens and our pets.

CURATOR INTERVIEW

SG: Right now we are experiencing a revolution in our understanding of genetics. Where do you think this is likely to lead us?

RMcM: Sequencing a human genome for \$1,000 has been regarded as a defining step and it will soon be a memory. When that happens, we will all have our genomes sequenced and all this data linked to health outcomes will allow us to unravel which variants cause disease and in what combinations. Rational decisions on healthy lifestyle choices or preventative therapies will be possible. Treatments aimed at curing existing maladies with genetically modified stem cells will come on stream. We will be able to pick the drugs that work for us and ultimately slow down ageing.

SG: On one hand we will all be living longer but will we produce more offspring? Where will babies come from in the future - will sex for reproduction end and will science take over completely?

RMcM: Genomic dating will be the first step where we can coldly compare notes with potential partners to ensure we don't have the same mutations—and maybe boost our child's immune system while we are at it. We will be able to screen all embryos for debilitating mutations before implantation and this might well overtake passion in making babies! While this might help to greatly improve the health of human populations, I doubt it will stop there. Ultimately genetic combinations which improve the physical characteristics, looks and intelligence of our children will be known and are likely to prove irresistible for those who can avail of them. Genomic dating might be part of this, but sex cells engineered with desirable variants will eventually become feasible. So ultimately science might well supplant spontaneity.

DR ROSS McMANUS—

HEAD OF GENOMIC RESEARCH LABORATORY, INSTITUTE OF MOLECULAR MEDICINE, TCD CONSIDERS FUTURE BABIES AND THE RAPIDLY GROWING FIELD OF GENOMICS

SG: A lot of people may have real concerns about this kind of future - what do you see as some of the ethical implications of enhancing our offspring?

RMcM: We are all mutants and while eradicating damaging mutations will be healthy, embarking on a process of selecting enhancing variants for future generations will be full of challenging ethical issues. There's a continuum here, but ultimately - do you want your child designed by a committee? What is an acceptable intervention at the genetic level and who decides? Will we end up with rationally designed genomes for a new era and will this be a good thing?

DR JULIANA ADELMAN—

RESEARCH FELLOW OF TRINITY LONG ROOM HUB AND HUMANITIES RESEARCHER WITH A FOCUS ON THE HISTORY OF SCIENCE AND MEDICINE CONSIDERS WHAT OUR PAST MAY TELL US ABOUT OUR FUTURE

SG: As a historian what would you predict for the future of our species?

JA: Historians are probably pessimists by nature. However, I will avoid giving a doom and gloom future forecast. History, particularly environmental history, reminds us that we are a species like any other which must meet specific needs to survive. Humans have proven incredibly adaptable and thereby incredibly successful at the survival game but we are now facing into a future that looks very likely to challenge that success. Population explosion, depleted resources and a changing global environment will all make their indelible mark on the future of our species. Can human ingenuity find a way out of our present predicament? Possibly. But I imagine that the future of our species might look a lot more like its past: a smaller, more dispersed population with less intensive resource exploitation.

SG: Can looking back help us understand the future of humankind?

JA: Looking back can remind us that we are not very good at predicting the future. We find it difficult to imagine the speed at which certain things might develop or how resistant other things are to change. There are constraints on our imagination. In 1923 JBS Haldane imagined babies made 'ectogenetically' (without sex and in artificial wombs). Haldane also thought that ectogenesis would bring an end to traditional relationships and families. In 1923 Haldane's ideas seemed far-fetched and dangerous. In 2010 it is clear that he was right (partially) about 'ectogenesis' but wrong about relationships. IVF seems a commonplace now but marriage and the nuclear family have endured so far.

CURATOR INTERVIEW

SG: What can the humanities bring to our understanding of issues around human enhancement?

JA: The humanities can ask a lot of questions. For a start, what do we mean by 'enhancement'? Are we really getting better? The humanities can encourage us not only to interrogate the technologies we may use to alter ourselves, but also the language in which we talk about these changes. Words have real effects and calling something an 'enhancement' immediately signifies a set of values.

SG: What legacies will the enhanced human leave behind?

JA: Probably the same things that humans have been leaving behind them for millennia: a lot of rubbish.

SG: How do you see the future of the body?

S: In this age of gene mapping, body hacking, neural jacking, organ switching, bioprinting, gender reassignment, prosthetic augmentation, avatar surrogates and telematic embraces, there is a proliferation of liminal spaces where what a body is and how a body operates becomes contestable. The body has become a floating signifier, fluid in form and function. What it means to die has become as important as what it means to stay alive. Dead bodies need not decompose. Near dead bodies need not die. To die now is to be disconnected from your life support system. What becomes important now is not merely the body's identity, but its connectivity—not its mobility or location, but its interface. Our death is postponed by our instruments, our aliveness is amplified by our interfaces.

SG: How can prosthetics transform us?

S: We are living in an age of excess and indifference. Of prosthetic proliferation. A prosthesis not as a sign of lack but rather as a symptom of excess. The body with a *Third Hand*, *Exoskeleton* locomotion and a *Prosthetic Head*. The body now experiences parts of itself as automated, involuntary and absent to its own agency. It is profoundly obsolete and empty. Its awareness can be extruded, its physicality withdraws. The body is now remotely propelled. It becomes an extended operational system. The body performs beyond the boundaries of its skin and beyond the local space it inhabits. We no longer function 'all-here' in this body nor 'all-there' in that body but 'partly-here' sometimes and 'partly-there' other times. Awareness slips and slides between spaces and situations. The body acts with indifference. Indifference as opposed to expectation. An indifference that allows something other to occur, that allows an unfolding in its own time and with its own rhythm. An indifference that allows the body to be suspended with hooks into its skin, that allows the insertion of a sculpture into its stomach and that allows an ear to be surgically constructed and stem-cell grown on its arm.

SG: How do new medical technologies challenge our understanding of what it is to be human?

S: Organs are extracted and exchanged. Organs are engineered and inserted. Blood flowing in my body today might be circulating in your body tomorrow. Ova are fertilized by sperm that was once frozen. The skin cells from an impotent male can now become sperm cells. And there is the possibility that the skin cells from female bodies can be re-engineered into sperm cells. The face of a donor body becomes a third face on the recipient. Limbs can be amputated from a dead body and reanimated on a living body. Hydraulic hearts now circulate the blood continuously and do not pulse. You might rest your head on the chest of your loved one. He's alive, he's warm to the touch, but there's no heartbeat. Cadavers can be preserved forever with plastination whilst comatose bodies can be sustained indefinitely on life-support systems. Cryogenically suspended bodies await reanimation at some imagined future. The dead, the near-dead, the un-dead and the yet to be born now exist simultaneously. This is the age of the Cadaver, the Comatose and the Chimera. The Chimera is the body that performs with mixed realities. A biological body, augmented with technology and telematically performing with virtual systems.

How can virtual worlds like Second Life transform our understanding of being human?

S: As well as an age of Circulating Flesh it's now also an age of Fractal Flesh and Phantom Flesh. Second Life is a second skin, an alternate embodiment and operation in multi-user online interactive spaces. Avatars can be prompted by bodies and actuated by their code. Perhaps what we need now is not a Second Life but a Third Life. A means by which avatars can access and interface with surrogate bodies and perform with them in the physical world. This would be an inverse motion-capture system where an artificial entity, imbued with an artificial intelligence would be able to generate its presence in the physical world with multiple bodies, in diverse situations and in remote locations. Embodied agents can be actualized as Prosthetic Heads, Partial Heads, Walking Heads, Articulated Heads and Swarming Heads. Proliferation of Artificial Intelligence and Artificial Life, blur what it means to be a biological body and whether it is any longer meaningful to remain human. Perhaps what it means to be human is not to remain human at all.

SG: Why grow an extra ear on your arm?

S: There was always a desire to engineer a soft prosthesis. An extra ear is presently being constructed on my forearm: A left ear on a left arm. An ear that not only hears but also transmits. A facial feature has been replicated, relocated and will now be rewired for alternate capabilities. Excess skin was created with an implanted expander in the forearm. By injecting saline solution into a subcutaneous port, the kidney shaped silicon implant stretched the skin, forming a pocket of excess skin that could be used in surgically constructing the ear. A second surgery inserted a Medpor scaffold with the skin being suctioned over it. Tissue cells grow into the porous scaffold fusing it to the skin and fixing it in place. At present it is only a relief of an ear. The third surgical procedure will lift the helix of the ear, construct a soft ear lobe and inject stem cells to grow even better definition. The final procedure will implant a miniature microphone that, connected with a wireless transmitter, will internet enable the ear in any Wi-Fi hotspot, making the ear a remote listening device for people in other places. This additional and enabled *Ear On Arm* effectively becomes an Internet organ for the body, an alternate anatomical architecture. A publicly accessible, mobile and acoustical organ. And with the stem cell growing of organs, with Organ Printing there will be an abundance of organs. It will no longer be a time of Bodies Without Organs but rather of Organs Awaiting Bodies, of Organs Without Bodies...

CURATOR INTERVIEW

SG: Why is it timely to consider the topic of human enhancement?

CS: Exciting opportunities for human enhancement are emerging due to converging technological advances in robotics and nanotechnology e.g. cybernetic body augmentations, artificial red blood cells etc; information technology e.g. artificial intelligence, computer-aided decision making, mobile computing, smart clothes etc; cognitive science e.g. augmented reality, nootropic drugs, neural implants etc; biotechnology e.g. in genetics, immunology, synthetic biology and bio-engineering. Technology convergence occurs when different technologies ‘converge’ towards fulfilling similar task or needs. Converging technologies tend to generate the most game-changing innovations. Technological synergies are now emerging in robotics and nanotechnology, information technology, cognitive science and biotechnology, which offer exciting opportunities for human enhancement. These advances will likely herald a Human 2.0 era where human enhancement technologies are one of the next science, technology and innovation frontiers. Technological nations embracing rather than fearing the advent of human enhancement will be future leaders in provision of human enhancement technology products, services and innovations.

SG: Is human enhancement new or has it always been happening?

CS: Human enhancement is not new. Human enhancement is an ongoing process underway since humans developed their first enhanced skills such as making fire, writing and the cultivation of food crops. Such technological enhancement of human capabilities has facilitated human population expansion from 200 million people 2000 years ago to almost 7 billion people on the planet today. Enhancement of human capabilities continues to be achieved in many ways, not all of which are genetics based. Everyday examples include reading, exercising, nutrition, studying, glasses, prosthetic limbs, hearing aids, computers, vaccination, smart phones and Viagra. Technological enhancement of human capabilities over the past 10,000 years allowed the transition of humans from a hunter gatherer lifestyle to producing

PROF CHARLES SPILLANE—

ESTABLISHED PROFESSOR, SFI INVESTIGATOR & HEAD OF GENETICS & BIOTECHNOLOGY LAB AT THE NATIONAL UNIVERSITY OF IRELAND GALWAY CONSIDERS THE PAST, PRESENT AND FUTURE OF HUMAN ENHANCEMENT.

sufficient food to sustain the livelihoods of billions. From an evolutionary perspective, we should not be blinded by short-term thinking in relation to ongoing development of many technologies that can improve human livelihoods. Technological enhancement of human capabilities will continue to be necessary for the human species to prosper and co-exist with other species in the face of changing biotic and abiotic environmental conditions.

SG: How can we weigh up the costs and benefits of human enhancement for improving the lives of humans?

CS: The development of new modes of human enhancement is an ongoing process and is inevitable as new needs and opportunities arise. The application of science to enhancement of the human condition has already led to major improvements in human health, lifespan and wellbeing for billions of people. Despite this, there are widespread fears of the future regarding technological enhancements in any sphere, and particularly regarding human enhancement. However, we should heed the flip side of the Precautionary Principle and assess both the ethics and the costs of inaction in terms of not pursuing enhancements that could improve human livelihoods in a manner desired by either individuals or groups. Any such enhancements should not of course infringe on the rights of others. Bioethicists can help society to better understand pros and cons of different technological applications. In the biomedical sphere a key emerging bioethical issue is to assess the implications of moving beyond therapy to enhancement of humans. If enhancement of academic, athletic (or indeed political) ability beyond the realm of normal human capability becomes possible what are the bioethical implications? Another nexus of bioethical debate will likely arise in terms of questioning what is ‘normal’, along with issues surrounding rights of access to human enhancement technologies (e.g. an equity debate on whether an enhancement divide may emerge between rich and poor). The development of a Smart Economy in Ireland will require an increased capability for Irish society and its elected representatives to better understand the relative benefits, costs and opportunities arising from new and emerging technological advances, including in the arena of human enhancement.



CATEGORIES

 EXTENDED ECOLOGIES

Humans cannot exist in isolation but are reliant on complex and messy ecosystems that support life on earth. The spaces that mediate our interactions throughout our lives are also expanding beyond physical constraints into online and virtual worlds. How will future humans live on this planet?

 AUTHORIZING EVOLUTION

Humans use many diverse methods to authorize the evolution of other species through what is often viewed as benign genetic manipulation, for example in gardening and pet breeding. Now humans are exploring ways to manipulate their own evolution with bio-hacking and neural engineering. Will we soon design our own genetic futures?

 AUGMENTED ABILITIES

Humans already use enhancements like eyeglasses, bicycles and vaccines to augment their abilities. Some dream of being able to live forever or having eyes at the back of their heads. our bodily form and function mediates how we interact with our fellow humans and surroundings. Can you imagine what strategies and augmentations you might want to employ to augment these interactions?

 NON-HUMAN ENCOUNTERS

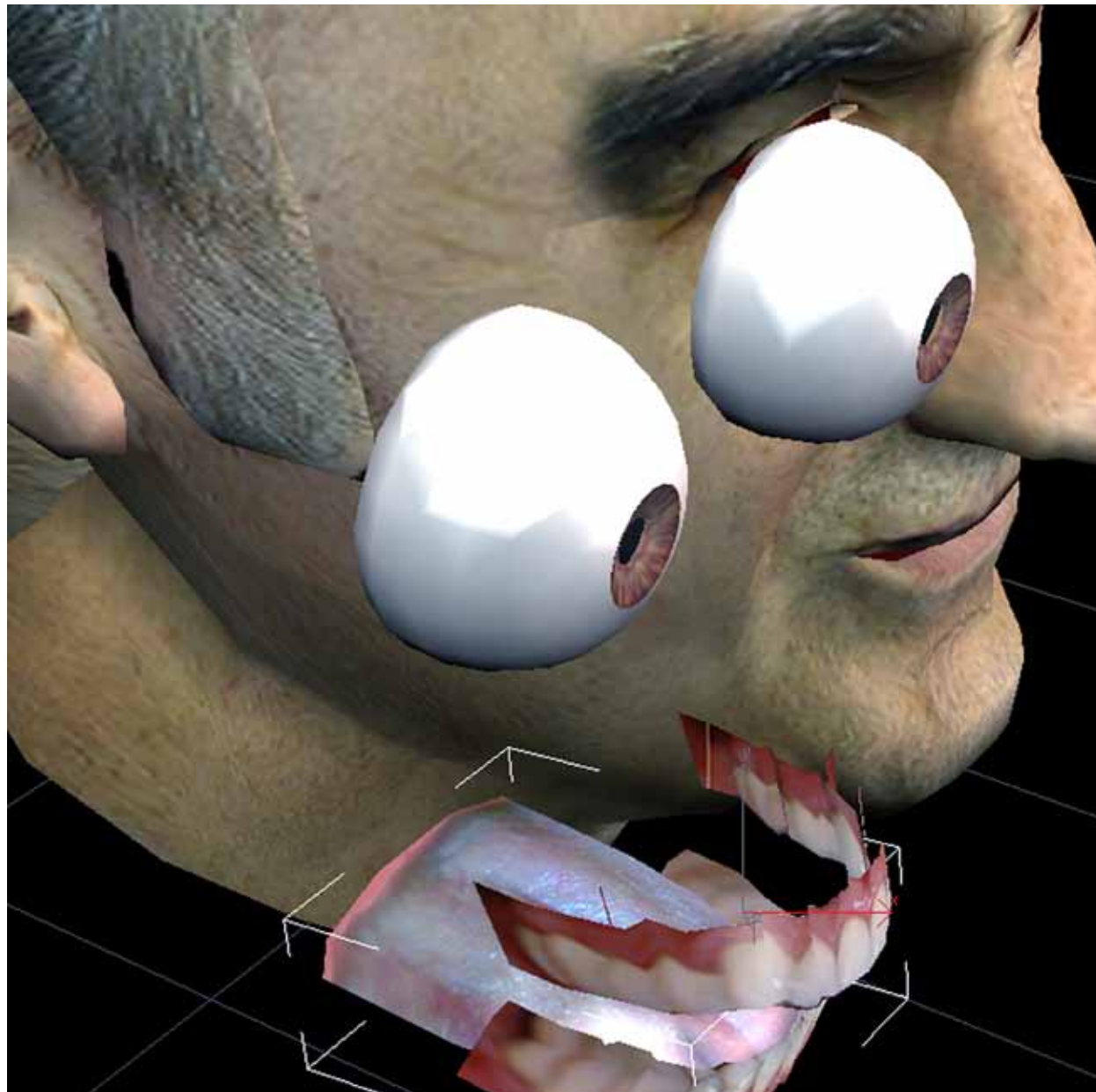
Humans share their lives with an enormous range of flora, fauna and machines. From our food to the bacteria in our body, to the reality of robotic companions, these encounters may greatly enrich or dilute our physical, social and cultural lives. What kind of non-human encounter will you choose or employ in the future?

 LIFE AT THE EDGES

With the help of new technologies and changing cultures, the birth and death of humans is fraught with ever more choices. How will we articulate these options in the future and what will inform our choices? Will you choose offspring produced from sex cells engineered with particularly desirable variants or a life assurance policy that covers the cost of cryogenic freezing?

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PROSTHETIC HEAD

STELARC
AUSTRALIA

3D MODEL (DETAIL):
BARRETT FOX

HUMAN+



Stelarc is Chair in Performance Art, Brunel University West London and Senior Research Fellow at MARCS Auditory Labs, University of Western Sydney. He is presently surgically constructing and stem-cell growing an extra ear. The EAR ON ARM will be electronically augmented and internet enabled. In 2010 he was awarded the Hybrid Arts Prize at Ars Electronica, Linz.



The *Prosthetic Head* is an embodied conversational agent that speaks to the person who interrogates it, with real-time lip synching, speech synthesis and facial expressions. The extensive data base of the *Prosthetic Head* enables it to respond adequately to personal, artistic and philosophical questions. In a way, it's a digital portrait of the artist. The creative capabilities of the *Prosthetic Head* include generating its own poetry and song-like sounds, which are different every time it is asked to perform. Recent developments have led to the Articulated Head, with a six-degree-of-freedom industrial robot arm. An attention model for the Articulated Head (THAMBS - Thinking Head Attention Model and Behavioural System), was developed with the Head able to perform vision tracking and sound location. Its active perception enables it to adapt to its environment and people it is interacting with. Just as a physical body exposed is inadequate, empty and involuntary, the *Prosthetic Head* project makes problematic notions of intelligence, awareness, identity, agency and embodiment.





THE HUMAN POLLINATION PROJECT

LAURA ALLCORN
USA

PHOTO (DETAIL):
LAURA ALLCORN

HUMAN+



Laura Allcorn is a designer, storyteller and maker who likes to re-imagine how the world could be. Her work is inspired by both social and natural science. Each of Laura's explorations involve extensive research, not just because she believes it is essential to the design process, but because it allows her to get lost in learning something new. Laura is currently an MFA candidate in the Applied Craft & Design program at Pacific Northwest College of Art + Oregon College of Art and Craft.



The Human Pollination Project brings attention to the human reliance on the pollination services provided by honeybees. Honeybees provide pollination for over one third of our food supply. What if humans had to assume the pollination responsibility from the honeybee? By adorning one's self with a hand pollination tool kit the wearer finds themselves in an uncomfortable and overwhelming position; forcing them to imagine assuming the vast and tedious pollination responsibilities of the bee. These hand pollination tool kits—designed especially for the pollination of fruit-bearing trees—spark dialogue around the social and environmental implications of a collapse of our primary pollinators.





IF NOT NOW THEN WHEN

JOHN ISAACS
UK

PHOTO (DETAIL):
JOHN ISAACS

HUMAN+



John Isaacs' work encompasses many different media, though much of it has origins in sculpture. The artist continually redefines his style, moving seamlessly through installation, sculpture, photography, film, painting and drawing. John Isaacs has exhibited extensively internationally, including at Young British Artists 6, Saatchi Gallery, Hayward Gallery, and at Tate Modern, London.



If Not Now Then When is a personal meditation on the physical memory of the body as its own landscape, as a place of inner emotional conflict, and not merely a depiction of obesity. As in the *Picture of Dorian Gray*—in which the painting ages and absorbs all the evil deeds of its sitter—this object can be seen as a kind of sponge. The heroic, somewhat classical, pose is absurdly contrasted against its physical form. This fictional and anonymous figure is a monument, a mirror to our current historical moment in which we confront everyday the side effects of our over consumption, waste and pollution, but are virtually powerless to change our course. This figure could well be a future monument to our own apathy and concealed guilt. Certainly it is a scapegoat.



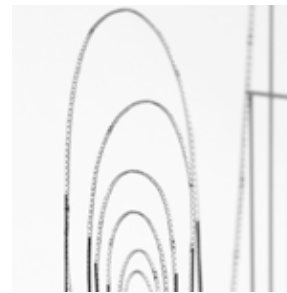


EUTHANASIA COASTER

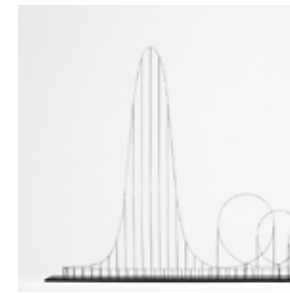
JULIJONAS URBONAS
LITHUANIA

PHOTO (DETAIL):
AISTĖ VALIŪTĖ &
DAUMANTAS PLECHAVIČIUS

HUMAN+



Julijonas Urbonas is a designer, artist, writer, engineer and PhD student in Design Interactions at the Royal College of Art, London. His work has been exhibited internationally and received many awards, including the Award of Distinction in Interactive Art, Prix Ars Electronica 2010, one of the most prestigious awards in media arts. Julijonas lives and works in London and Vilnius.



Euthanasia Coaster is a hypothetical euthanasia machine in the form of a roller coaster, engineered to humanely—with elegance and euphoria—take the life of a human being. Riding the coaster's track, the rider is subjected to a series of intensive motion elements that induce various unique experiences: from euphoria to thrill, from tunnel vision to loss of consciousness and eventually death. Thanks to the marriage of the advanced cross-disciplinary research in aerospace medicine, mechanical engineering, material technologies and of course gravity, the fatal journey is made pleasing, elegant and meaningful. Celebrating the limits of the human body but also the liberation from the horizontal life, this 'kinetic sculpture' is in fact the ultimate roller coaster. John Allen, former president of the famed Philadelphia Toboggan Company, once said that "the ultimate roller coaster is built when you send out twenty-four people and they all come back dead. This could be done, you know."





SONG OF THE MACHINE

ANAB JAIN,
JON ARDERN,
DR PATRICK DEGENAAR,
JUSTIN PICKARD &
DR ANDERS SANDBERG
INDIA/UK

DETAIL (DETAIL):
ANAB JAIN,
JON ARDERN
& JUSTIN PICKARD

HUMAN+



Song of the Machine is produced by Superflux Lab, the research wing of Superflux, a London-based design studio and is a project by designers Anab Jain and Jon Arder with scientist Dr Patrick Degenaar, ethicist Dr Anders Sandberg and futurist Justin Pickard.



What if we could change our view of the world with the flick of a switch? The emerging field of optogenetics explores this possibility; combining genetic engineering and innovative optoelectronics to manipulate individual nerve cells with light. With this technology, scientists are developing a new form of retinal prostheses, capable of bringing sight to the blind. Unlike the electrode implants of bionic vision this science modifies the body from within. By using a virus to infect the degenerate eye with a light-sensitive protein, wearable optoelectronics can establish a direct optical link to the brain. It is as if the virus gives the body ears to hear the *Song of the Machine*, allowing it to sing the world into being. *Song of the Machine* explores the possibilities of this new, modified—even enhanced—vision, where wearers adjust for a reduced resolution by tuning into streams of information and electromagnetic vistas, all inaccessible to the ‘normally’ sighted.





OBLIQUE—IMAGES FROM STELARC'S EXTRA EAR SURGERY

NINA SELLARS
AUSTRALIA

PHOTO (DETAIL):
NINA SELLARS

HUMAN+

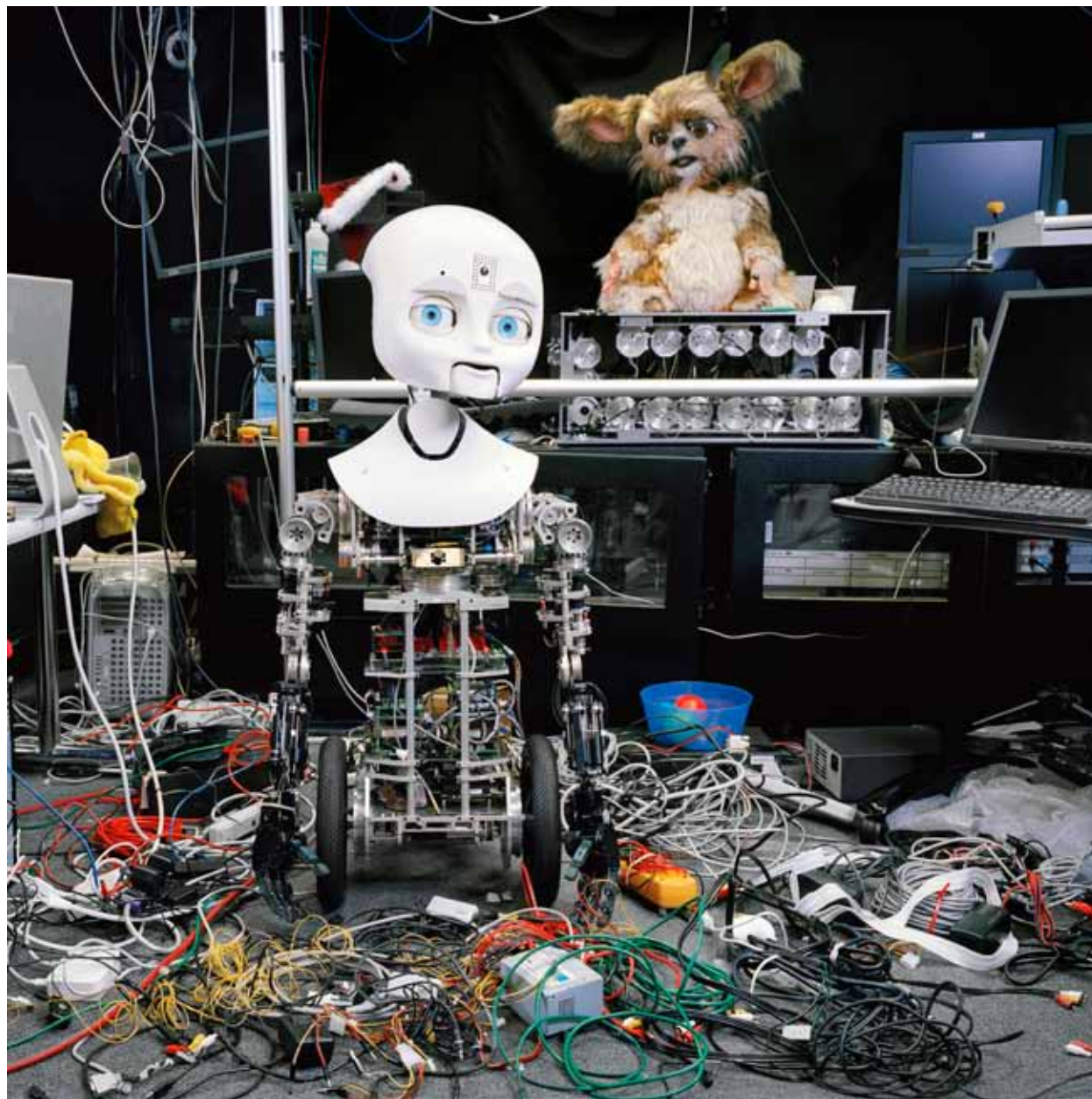


Nina Sellars is an Australian artist who is based in Melbourne, and resides part of each year in London. Sellars lectures in Drawing at the Faculty of Art & Design, Monash University. Sellars often works collaboratively with scientists and artists on cross-disciplinary projects.



In *Oblique* the twisted bodies, discoloured flesh and extensions into the bodily space normally associated with Baroque imagery have been transformed into an extended body, revealing a palette of Mannerist-like flesh formed by a mix of iodine stains and restricted blood flow. The 'irregularly shaped pearl' of the Baroque has become a cultivated pearl here: an artificial ear scaffold seeded with the performance artist Stelarc's living cells. *Oblique* thus provides an ambiguous space for an anatomically augmented body, situated as it is between a surgical theatre and the theatricality of the Baroque. Each image combines a photographic close-up with a proscenium arch of darkness. Reminiscent of a 17th century stage, the arch hides the 'behind the scenes' machinery to frame a selected area of action for 'front of house' viewing. In offering a glimpse of an ongoing surgical spectacle, *Oblique* participates in the rupture of the body ideal.





HUMAN VERSION 2.0

YVES GELLIE
FRANCE

PHOTO (DETAIL):
YVES GELLIE

HUMAN+

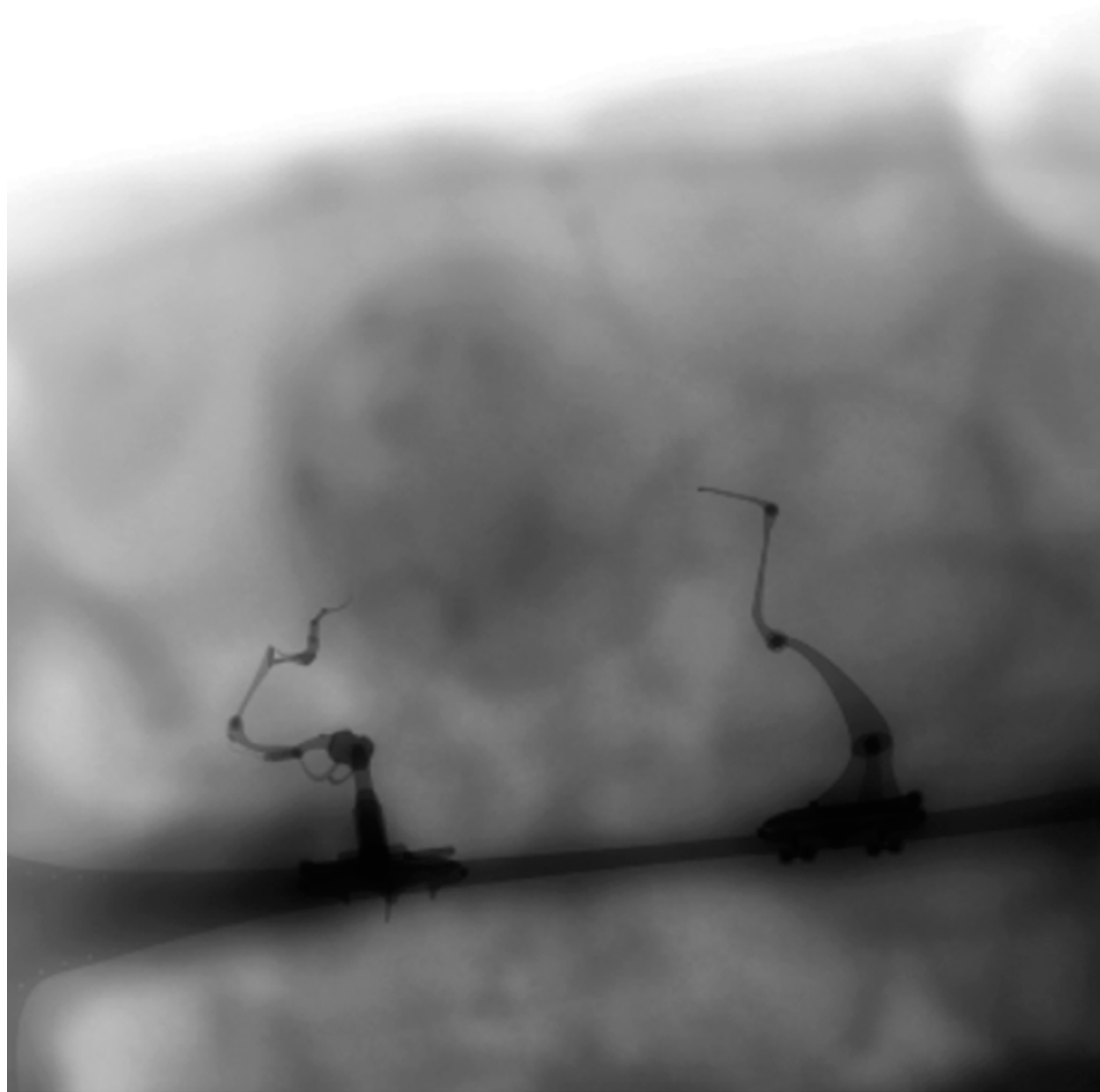


French born, Yves Gellie studied medicine at the University of Bordeaux. He practiced tropical medicine in Gabon before beginning his career in photography. Yves' work lies between documentary and contemporary art and he has developed a style described as an iconographic selection of the reality underlying day-to-day life and its trivial aspects.



Day after day, we give more and more power to machines for example decisions, judgements, intervention and memory, to a point where our dependence has become increasingly obvious. We are not far from considering imminent fusion with the machine, from successfully extending longevity and perfecting artificial intelligence. These works explore the world of major scientific research laboratories dedicated to the development of humanoid robots. These robots bring questions about the destiny of humans, the outlook of humans on themselves, on their conscience, on their evolution and their future.



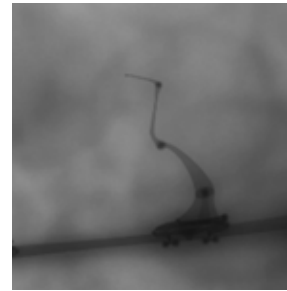


APHASIA MECHANICA

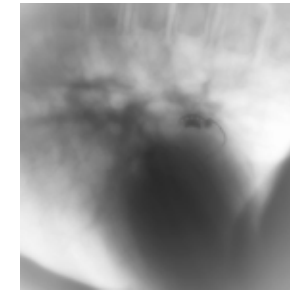
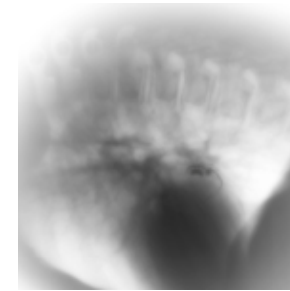
DANNY WARNER
USA

PHOTO (DETAIL):
DANNY WARNER

HUMAN+



Danny Warner is a US based designer. Danny has an MFA in Design from the University of Notre Dame, his motion work appears in various venues and has been exhibited in galleries, film festivals and other events in North America and Europe. Danny also designs for a small creative agency, writes and teaches in the US.



This filmed work imagines an evolutionary future of physical interrelationships between organism and technology. Within this vast body of porous bone and watery ligaments witness a world of nanoscopic machines boring holes, tendrils slipping along, quietly doing their unknown work in the physical, corporeal medium of the human body. This work investigates an aspect of our collective, bared scaffolding as potential host to nanopotians, molecular machines, nano-inorganics and self-assembling molecular systems. Each element involves an ambiguous dance with the mechanical and technological 'life' that has become a large part of our cultural, physical and physiological architecture. Are the nano-machines destructive or constructive? Autonomous or controlled? Symbiotic or parasitic? Thinking or rote?





STRATEGIES IN GENETIC COPY PREVENTION

THE CENTER FOR
POSTNATURAL HISTORY
USA

PHOTO (DETAIL):
THE CENTER FOR
POSTNATURAL HISTORY

HUMAN+

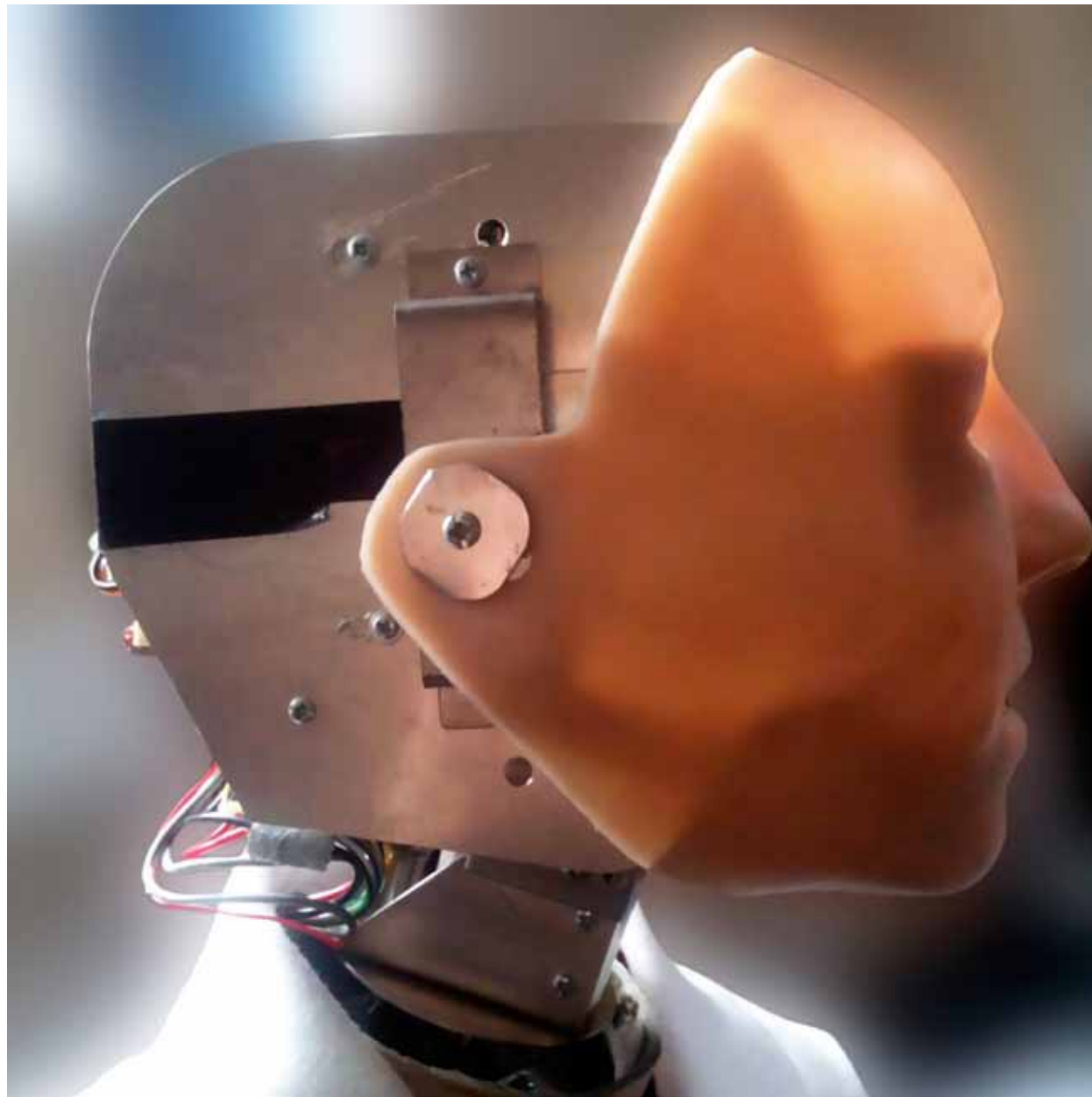


The Center for PostNatural History is a public outreach centre dedicated to the intersection of culture, nature and biotechnology. The PostNatural refers to life forms that have been intentionally altered by humans through domestication, selective breeding and genetic engineering. Towards this end the CPNH maintains a collection of living, preserved and documented specimens of PostNatural origin.



If life does anything, it makes copies of itself. It is one of the traits every living thing shares with every other living thing. Since the dawn of agriculture and animal husbandry, humans have developed increasingly elaborate strategies for preventing this self-copying behavior when they view its product as undesirable. The reasons for doing this are as numerous as the means by which it is accomplished. Included in this exhibit is a small selection of strategies of reproductive control that have been developed and used in modern times.





MY ROBOT COMPANION

ANNA DUMITRIU,
ALEX MAY,
PROF KERSTIN
DAUTENHAHN &
DR MICHAEL WALTERS
UK

PHOTO (DETAIL):
ANNA DUMITRIU
& ALEX MAY

HUMAN+



Anna Dumitriu is an artist whose work blurs the boundaries between art and science. Her installations, interventions and performances use a range of digital, biological and traditional media. Alex May is an artist working with digital projection, 3D video mapping, illumination, and optics to create animated trompe l'oeil effects using scientific theories of perspective and projective geometry. Dumitriu and May are Visiting Research Fellows: Artists in Residence in the Adaptive Systems Research Group at The University of Hertfordshire.



What will we do when life extension technologies become the norm and we enter an age when there are no longer sufficient numbers of young people to care for the ageing population? One likely solution will be to employ robots to care for us, to entertain us and even to provide companionship. *My Robot Companion* asks what kind of robots do we really want? This project of speculative robot heads is designed to provoke the viewer to consider their future robot companions and how they should look, move and behave.





H5N1

NERVE THEORY
TOM SHERMAN &
BERNHARD LOIBNER
AUSTRIA/CANADA/USA

PHOTO (DETAIL):
COURTESY OF ELEKTRA
FESTIVAL, MONTREAL



Nerve Theory is the collaborative identity of artists Tom Sherman (Canada/USA) and Bernhard Loibner (Austria). Nerve Theory was founded in 1993 and remains active as a performance and recording duo.



The *H5N1* audio works were produced for radio broadcast on the Austrian Broadcasting Corporation by Nerve Theory in 2006. These broadcasts focused on the bird flu virus, H5N1, and the hysteria surrounding the inevitable global influenza pandemic—this was prior to the H1N1 (Swine Flu) outbreak in 2009. The broadcast used the idea of the evolving, mutating H5N1 virus as a launch pad for a series of statements about the world we live in, observing and describing media viruses and a whole spectrum of living, evolving ideas, including potential viral pandemics and issues of surveillance and the spread of state-sponsored paranoia.





NATURAL HISTORY OF ENIGMA

EDUARDO KAC
USA

PHOTO (DETAIL):
RIK SFERRA

HUMAN+

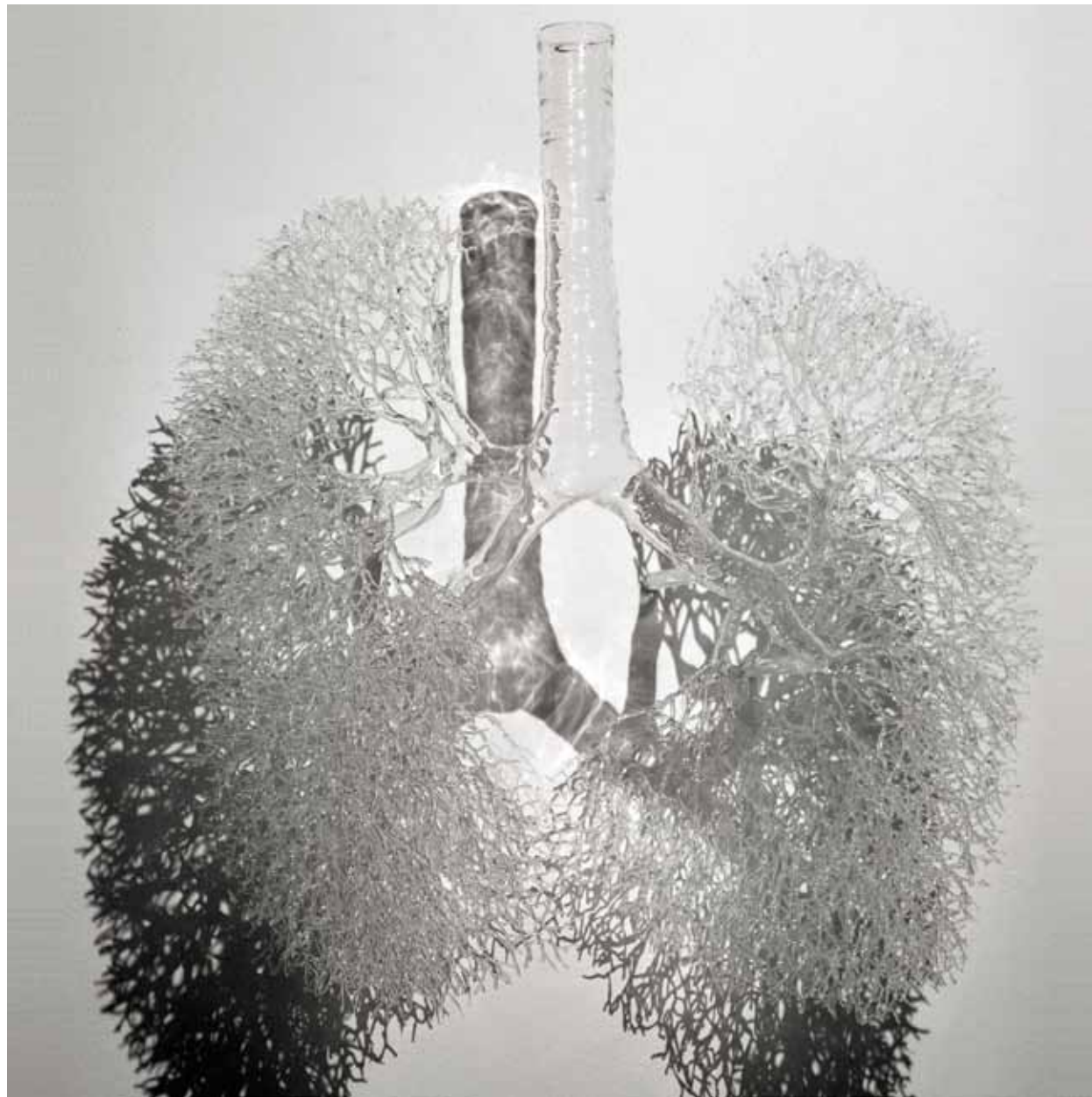


Since the early 1980s, Eduardo Kac has pioneered new art forms to create art that explores the limits of locality, light, language and life. His work has continuously broken new ground, and has progressively focussed on the relationship among and between humans, machines, animals and other life forms.



The central work in the *Natural History of the Enigma* is a 'plantimal', a new life form created by Eduardo Kac that he calls Edunia, a genetically-engineered flower that is a hybrid of the artist and Petunia. The Edunia expresses Kac's DNA exclusively in its red veins. The new flower was invented by and produced by the artist through molecular biology. It is not found in nature.





CAPACITY, PROCESS & PLEASURE/ PAIN

ANNIE CATTRELL
UK

PHOTO (DETAIL):
P. CATTRELL

HUMAN+



The dialogue between the empirical and the theoretical informs Annie Cattrell's approach to making art. The artist employs a range of research and material strategies in order to make visible, in three dimensions, the sites where subtle yet significant changes and transformations continuously happen inside the human body and brain.



Capacity and *Process* reveal the body's pulmonary and alimentary systems. The organs are deliberately isolated and represented using transparent scientific laboratory glass to emphasise the transitory and ethereal nature of life, making physical and conceptual connections between the processes of oxygen becoming breath and food becoming energy. *Pleasure/Pain* was made in collaboration with Professor Morten L Kringelbach of Oxford University. Using state of the art brain scanning data from Diffusion and functional Magnetic Resonance Imaging they three dimensionally mapped the active overlapping cerebral pathways and volumes of both pleasure and pain onto the respective organs.



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YOUR PERSONAL BIOSPHERE

ZBIGNIEW OKSIUTA
POLAND

PHOTO (DETAIL):
GEIR TORE AAMDAL

HUMAN+



Zbigniew Oksiuta is an artist, architect and scientist born in Mulawicze, Poland. He studied architecture at The Warsaw Polytechnic. Zbigniew Oksiuta is a Professor at Rensselaer Polytechnic Institute in Troy, NY.



In this work the artist imagines taking a small patch of farmland from his childhood and rolling it into his own personal cocoon. In this maximally condensed inverted spherical garden a community of organisms, similar to the plants, animals and people of his grandfather's land will live together in his own personal biosphere. The artist imagines that this unique transparent sphere could be a part of our bodies. It will grow, develop and bloom with us. It is beautiful when young, but it will become old like its owners and eventually dry and wrinkle.



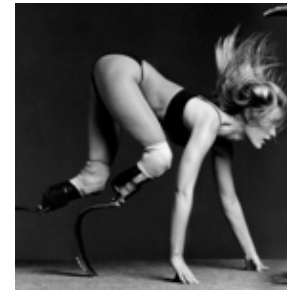


PORTRAITS OF AIMEE MULLINS

HOWARD SCHATZ
USA

PHOTO (DETAIL):
HOWARD SCHATZ

HUMAN+



The photographic works of Howard Schatz are exhibited in museums and photography galleries internationally and are included in innumerable private collections. He has received international acclaim for his work and has published editorial work in Time, Sports Illustrated, Vogue, Vogue Italia, GQ Italia, The New York Times Magazine and The New Yorker.



Aimee Mullins first received worldwide media attention as an athlete. Born without fibulae in both legs, Aimee's medical prognosis was discouraging; she was told she would never walk, and would likely spend the rest of her life using a wheelchair. In an attempt at independent mobility, doctors amputated both her legs below the knee on her first birthday. By age two, she had learned to walk on prosthetic legs, and spent her childhood doing the usual athletic activities of her peers. While studying at Georgetown University, she set her sights on making the US Team for the 1996 Atlanta Games. Outfitted with woven carbon-fiber prostheses that were modeled after the hind legs of a cheetah, she went on to set World Records in the 100 metres, the 200 metres and the long jump, sparking a frenzy over the radical design of her prototype sprinting legs. In 1999, Aimee made her runway debut in London at the invitation of fashion designer Alexander McQueen. In February 2011, she was named as the new Global Brand Ambassador to the world's largest beauty brand L'Oreal Paris, another cultural milestone. An influential voice in today's culture, she is regularly invited to share her ideas at various corporations and global conferences like TED and TEDMED.



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REPRODUCTIVE FUTURES

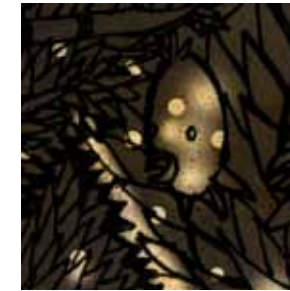
ZOE PAPADOPOULOU
& DR ANNA SMAJDOR
UK

ILLUSTRATION (DETAIL):
MATT SAUNDERS

HUMAN+

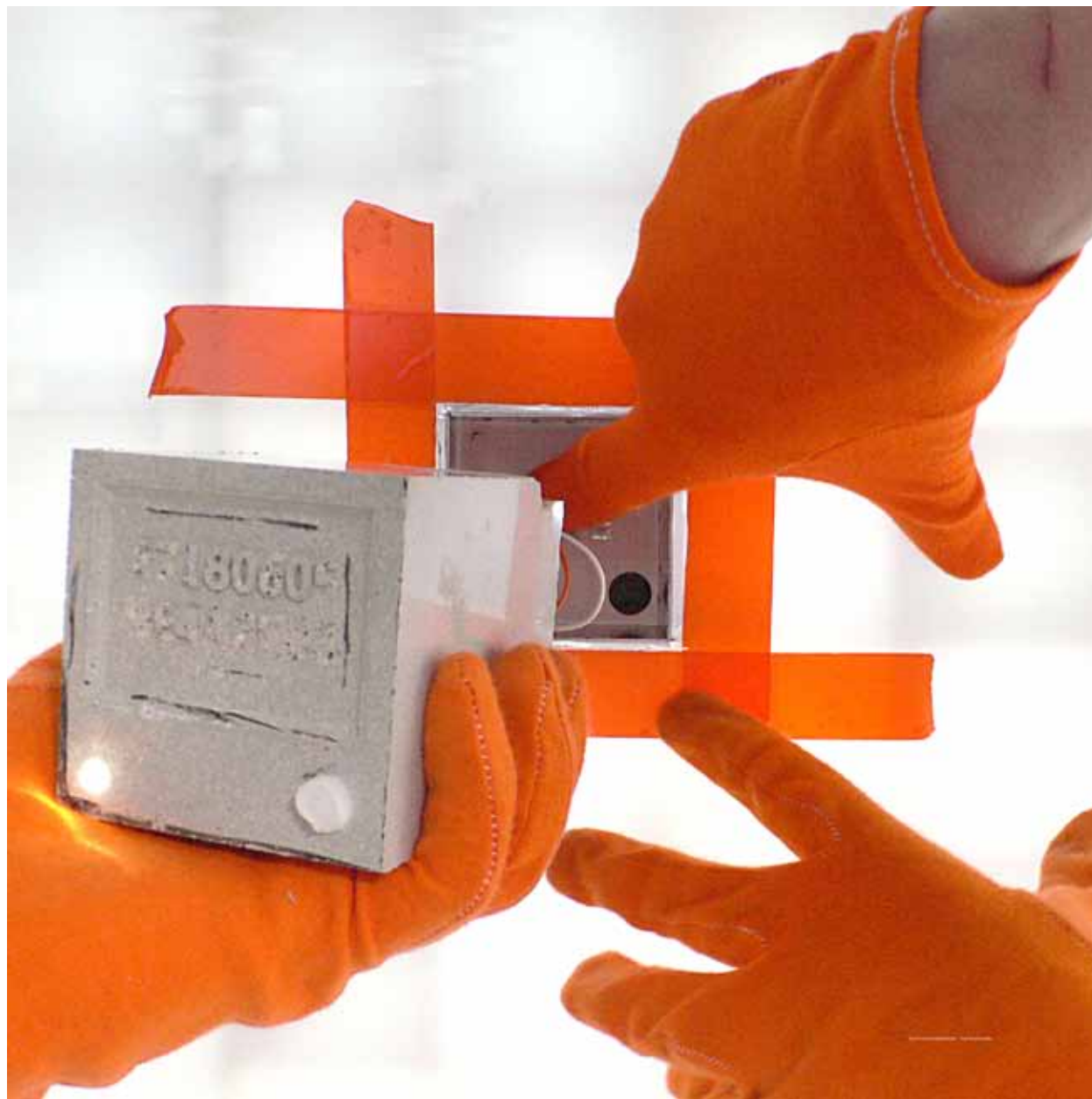


Zoe Papadopoulou is a UK based artist whose work focuses on public engagement and performance. Her work avoids debate on the pros and cons of emergent technologies; instead she removes the subjectivity and replaces it with the possible and improbable implications of our inevitable futures. Dr Anna Smajdor is a lecturer in Ethics at the University of East Anglia. Her PhD thesis was an exploration of ethical issues related to artificial gametes. In addition, Anna is the co-author of the book "From IVF to Immortality" on the controversies raised by developments in reproductive technologies and the role of law and regulation in this field.



From the stork to the invention of the microscope, the 'birds and the bees' to IVF—how will these stories evolve as our methods of reproduction become increasingly more diversified? The creation of artificial gametes from stem cells or somatic cells has the potential to fundamentally change the way we perceive parenthood and reproduction. Sperm and eggs could be created from anyone's cells, regardless of age, gender or sexuality. This multidisciplinary project investigates how scientific and technological developments influence historical stories and narratives, explaining 'where we come from'. By exploring new reproductive scenarios, this project aims to create the space for a broader discussion on Artificial Reproductive Technologies (ART) that can engage people in the possibilities these advances present.





MISSION ETERNITY DIGITAL AND MORTAL REMAINS OF TIMOTHY LEARY, 2008–2011

etoy.CORPORATION
SWITZERLAND/GERMANY/AUSTRIA/USA

PHOTO (DETAIL):
etoy.CORPORATION

HUMAN+

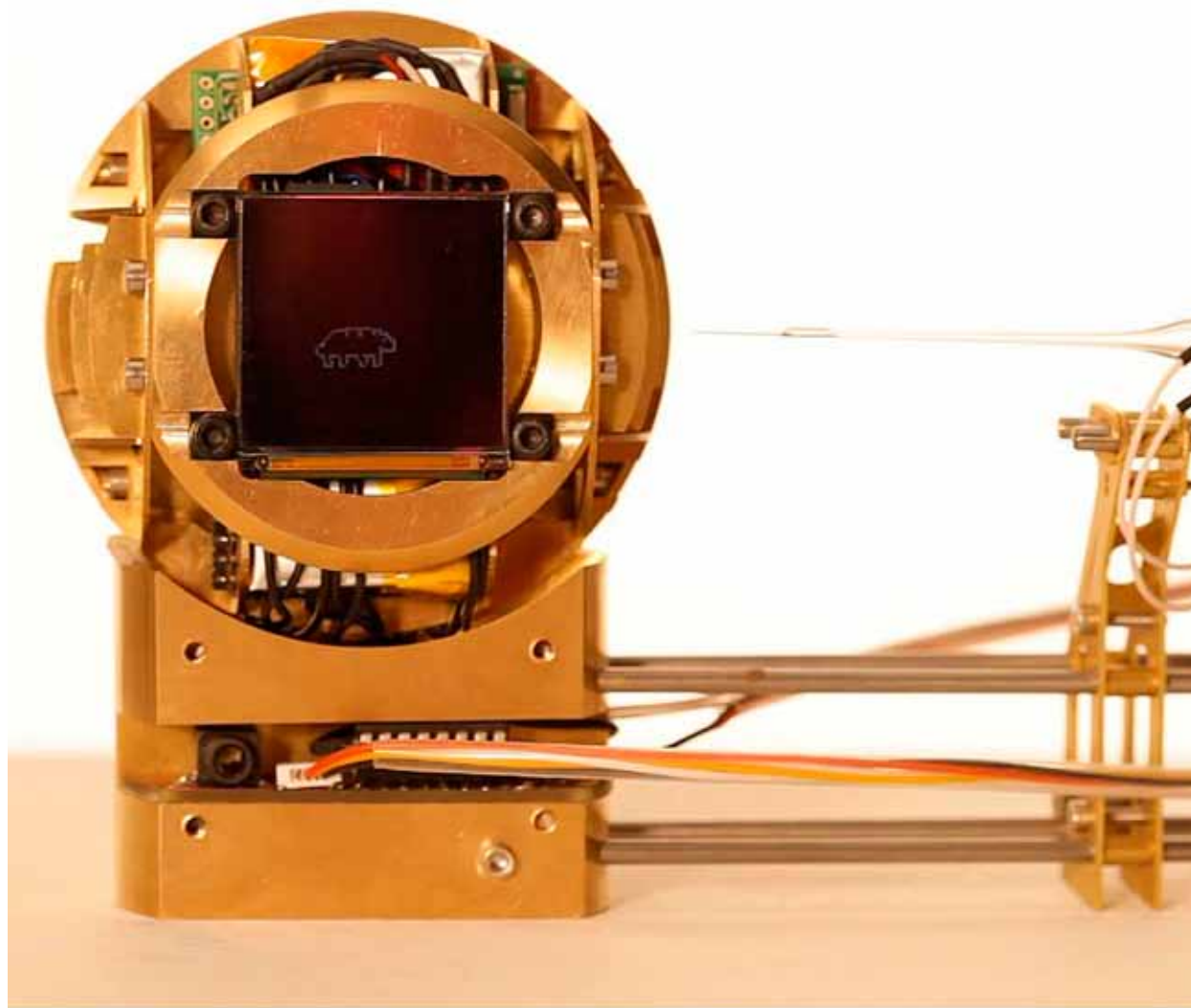


etoy.Corporation is art and invests all resources in the production of art beyond traditional dimensions. Their aim is to take the resources and legal framework of our time to create a corporate sculpture - a private held shareholder company registered in Zug/Switzerland. The company issues etoy. SHARES to compensate its artists, investors, collectors and supporters. etoy - founded in 1994 - is known for its pioneering role in internet art.



Mission Eternity is a bridge that connects human memory space with electric impulses and mortal remains, life with death and art with technology. The goal is to collect, store and process information of human beings before and after they pass away and to suggest sculptural objects reflecting/extending this infosphere: visual information, the voices of the dead, statistics and ascii text collected from governmental databases, family records and online sources. Mission Eternity Pilots cross the ultimate boundary to investigate afterlife, the most virtual of all worlds and explore the artistic portrait for the information society. The work plays with light, fragile colours, focus, distance, loss and the human brain's very special capacity to compensate missing parts of human faces. Pilot Timothy Leary (1920-1996) left etoy a large collection of documents and 32g of mortal remains that were integrated into the system on May 26, 2007.





TARDIGOTCHI

S.W.A.M.P. &
TIAGO RORKE
USA/NEW ZEALAND

PHOTO (DETAIL):
BUREAU

HUMAN+

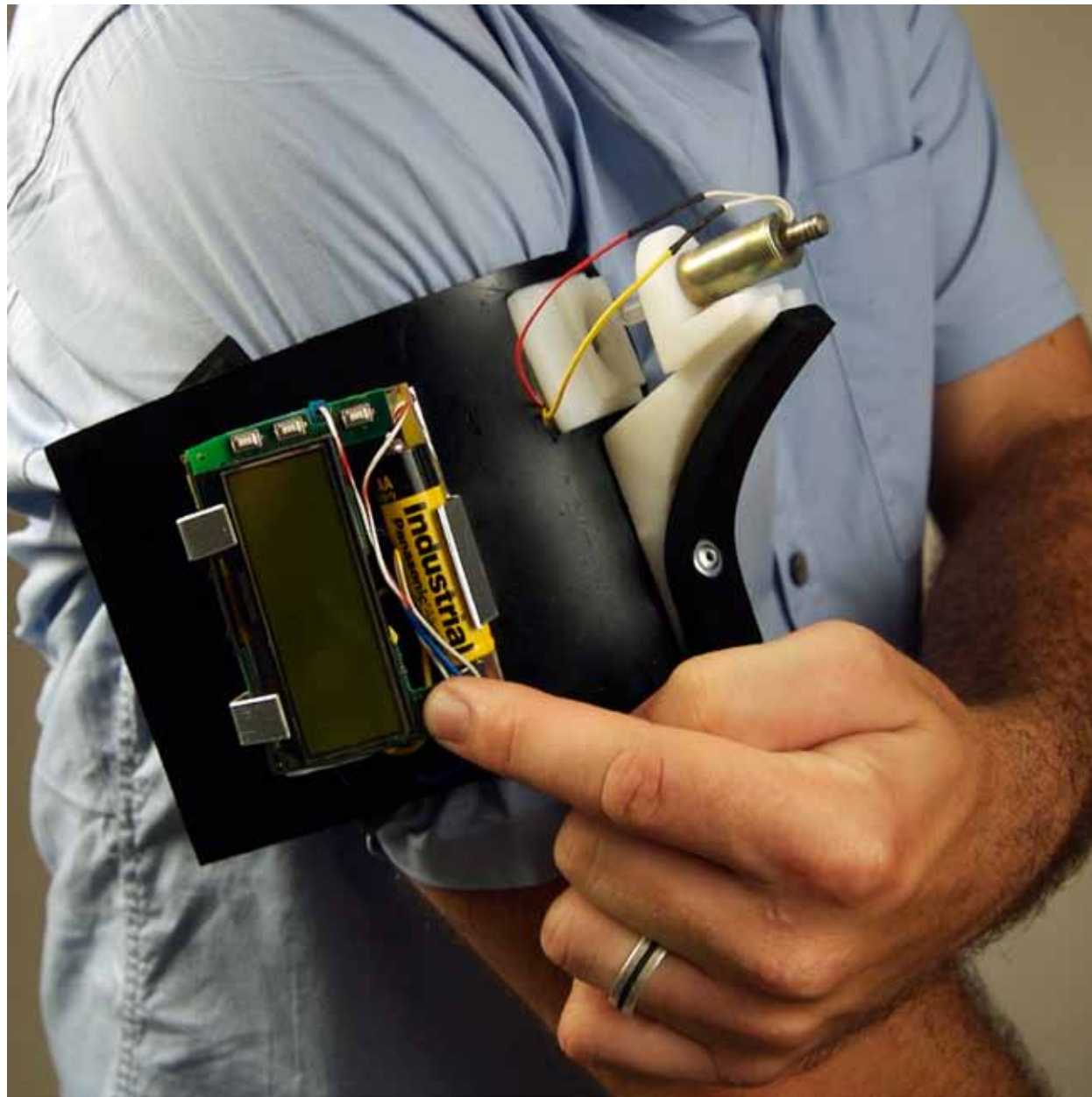


S.W.A.M.P. (Studies of Work Atmospheres and Mass Production) is the collaborative effort of artists Douglas Easterly and Matt Kenyon. Their work focuses on critical themes addressing the effects of global corporate operations, mass media and communication, military-industrial complexes and general meditations on life. Tiago Rorke is a designer currently working as a teaching fellow at Victoria University of Wellington. Tiago's studio practice reflects a keen interest in programming and electronics, especially projects that deal with ubiquitous computing technologies.



Tardigotchi features two pets: a living organism and an alife avatar. These two disparate beings find themselves the unlikely denizens of a portable computing enclosure. The main body for this enclosure is a brass sphere, housing the alife avatar and a tardigrade—a common microorganism measuring half a millimetre in length. The alife avatar is a caricature of this tardigrade, its behaviour is partially autonomous, but it also reflects a considerable amount of expression directly from the tardigrade's activities.





IMPROVISED EMPATHETIC DEVICE (I.E.D.)

S.W.A.M.P.
USA

PHOTO (DETAIL):
JAMES JOHNSON

HUMAN+

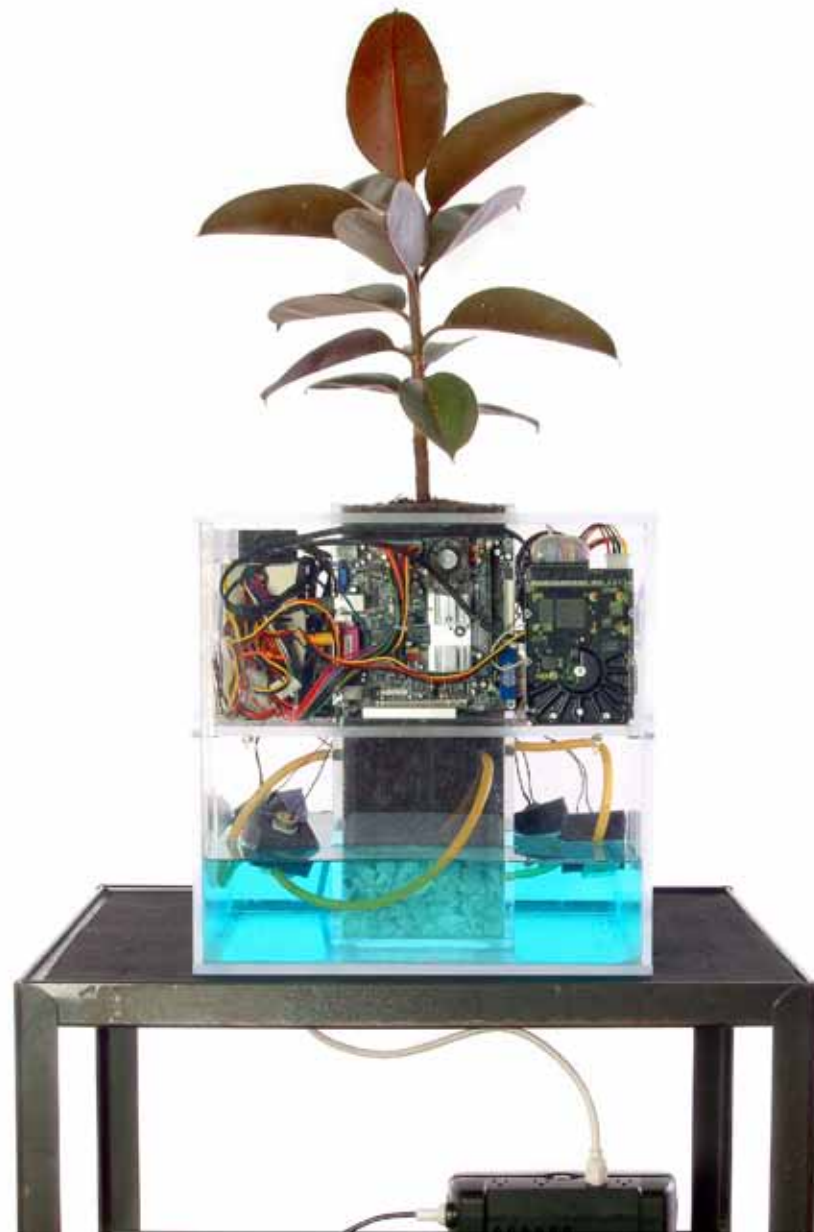


S.W.A.M.P. (Studies of Work Atmospheres and Mass Production) is the collaborative effort of artists Douglas Easterly and Matt Kenyon. Their work focuses on critical themes addressing the effects of global corporate operations, mass media and communication, military-industrial complexes and general meditations on life.



A custom software application continuously monitors a website (icasualties.org) that updates the personal details and numbers of slain US soldiers. When new deaths are updated on the website, the data is extracted and sent wirelessly to custom hardware installed on the *I.E.D.* armband. The LCD readout displays the soldiers' name, rank, cause of death and location and then triggers an electric solenoid to drive a needle into the wearer's arm, drawing blood and immediate attention to the reality that a soldier has just died in the Iraq war.



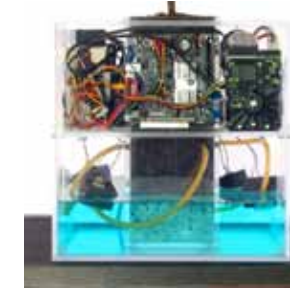


SPORE 2.0

S.W.A.M.P.
USA

PHOTO (DETAIL):
LUKE HOVERMAN

HUMAN+



S.W.A.M.P. (Studies of Work Atmospheres and Mass Production) is the collaborative effort of artists Douglas Easterly and Matt Kenyon. Their work focuses on critical themes addressing the effects of global corporate operations, mass media and communication, military-industrial complexes and general meditations on the life.

Spore 2.0 is a self-sustaining ecosystem for a rubber tree plant purchased at Home Depot. In this project, Home Depot is responsible for the plant in two ways: first, an unconditional guarantee to replace it, second, through an implied cybernetic contract. An onboard computer uses a Wi-Fi connection to access Home Depot stock quotes once per week, keeping a database of the week ending stock values. From the fluctuations in Home Depot stock, programs and circuitry connected to the rubber tree are controlled accordingly. If the company does well by showing stock growth, so does the plant. If the company suffers losses, *Spore 2.0* does not get watered. If the plant should perish, due to poor stock performance, it is returned to Home Depot and replaced with another at no additional cost.





AREA V5

LOUIS-PHILIPPE DEMERS
CANADA

PHOTO (DETAIL):
LOUIS-PHILIPPE DEMERS

HUMAN+



Louis-Philippe Demers makes large-scale installations and performances. His main areas of work are entertainment robotics and interaction design. Over the past two decades, he has participated in more than seventy artistic and stage productions and has built more than 300 machines. Louis-Philippe's works has been featured at major international venues including Lille 2004, Expo 1992 and 2000, Sonambiente, ISEA, Siggraph and Sonar. He received the Distinction of Prix Ars at Ars Electronica, 1996.



Area V5 aims to trigger Uncanny Valley—the point at which humans start to feel physical unease with robotic agents. Recent developments in the field of social robotics and artificial intelligence suggest a prominent role of eye movement in establishing essential non-verbal dialogue between humans and machine. The installation invites the viewer to experiment with the enigmatic gaze of disembodied eyes. The title of the work refers to the visual area V5 in the brain cortex which is thought to play a major role in the perception of motion.



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SYNTHETIC IMMUNE SYSTEM

TUUR VAN BALEN
& JAMES CHAPPELL
BELGIUM/UK

PHOTO (DETAIL):
TUUR VAN BALEN

HUMAN+



James Chappell is a PhD student at the Centre for Synthetic Biology at Imperial College London and Tuur Van Balen is a London based designer. Since 2008 they have been collaborating on various design projects dealing with synthetic biology.



Synthetic biology's potential to make healthcare more personal and participatory might turn us into our own doctors and pharmacists; constantly monitoring and tweaking our body. It might even allow us to externalise our immune system by outsourcing metabolic processes to external microorganisms, such as yeast. Such a synthetic immune system would be tailored to one's genetic predisposition, age, lifestyle and would sense and diagnose anomalies in our body to produce and deliver chemicals accordingly. In *Synthetic Immune System*, the yeasts are fed with water and sugar from the central bowl. When using the spoon to stir the mixture, a drop of blood drips into the system to disclose your body's state. Your synthetic immune system will need feeding every evening to produce for your needs. Every morning you can use the mouthpiece to take in the different remedies produced specifically for that day.





COOK ME— BLACK BILE

TUUR VAN BALEN
BELGIUM

PHOTO (DETAIL):
TUUR VAN BALEN

HUMAN+



Tuur Van Balen uses design to explore the political implications of emerging technologies. Through designing and experimenting with new interactions, he constructs thought-provoking new realities.



Hippocrates' theory of the four humours sees the body as made up of four basic substances: yellow bile, blood, phlegm and black bile, each linked to a specific temperament. The theory inspired blood-letting, a common medical practice aimed at restoring both physical and mental health by bringing these bodily fluids back into balance. Black bile, the fictional of these four fluids, is linked to the humour of melancholy. *Cook Me—Black Bile* references this historical medical practice by proposing a new form of cooking, guided by one's personal metabolism. With the right ingredients and recipe, one could perhaps finely balance the feeling of melancholy; through cooking for and from one's own body. In this work a special cooking instrument allows a leech to parasite on the forearm of the artist. Using the satiated leech the artist prepares a blood mousse accompanied by oyster mushroom, a redcurrant sauce and blood sorrel.





FORAGERS

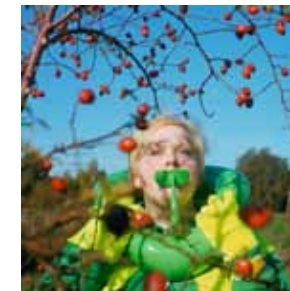
ANTHONY DUNNE &
FIONA RABY
UK

PHOTO (DETAIL):
JASON EVANS

HUMAN+

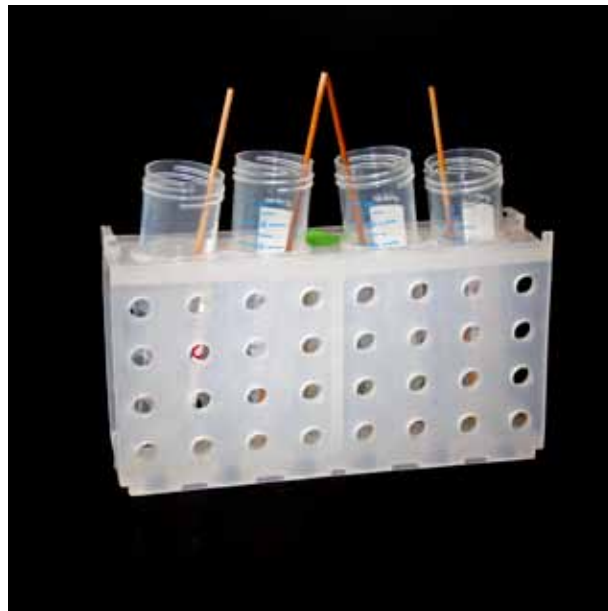


Anthony Dunne is Professor and Head of the Design Interactions department at the Royal College of Art in London. Fiona Raby studied Architecture at the RCA before working for Kei'ichi Irie Architects in Tokyo. Their work has been exhibited and published internationally and is in the permanent collections of MoMA, the Victoria & Albert Museum as well as several private collections. Dunne & Raby use design as a medium to stimulate discussion and debate amongst designers, industry and the public about the social, cultural and ethical implications of existing and emerging technologies.



The world is running out of food—we need to produce 70% more food in the next 40 years according to the UN. Yet we continue to over-populate the planet, use up resources and ignore all the warning signs. It is completely unsustainable. In this scenario, a group of people take their fate into their own hands and start building DIY devices. They use synthetic biology to create ‘microbial stomach bacteria’, along with electronic and mechanical devices, to maximise the nutritional value of the urban environment, making-up for any shortcomings in the commercially available but increasingly limited diet. These people are the new urban foragers.



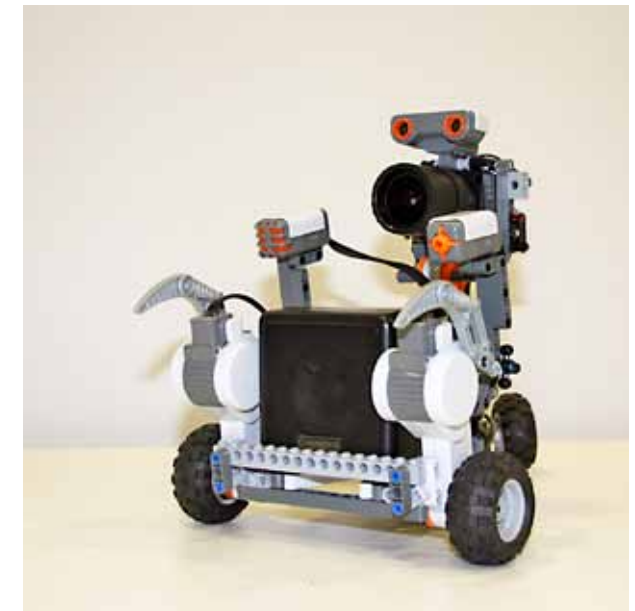
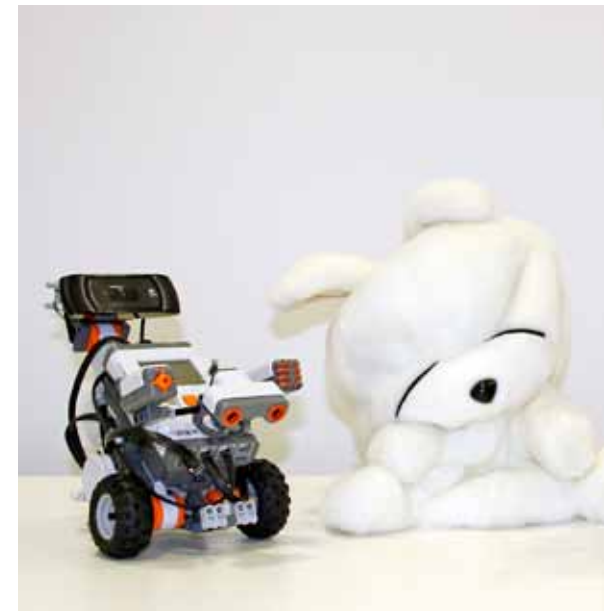


FREE WILL

DR AOIFE McLYSAGHT, PROF FIONA NEWELL,
PROF HUGH GARAVAN, PROF LUKE O'NEILL,
PROF KEN WOLFE
IRELAND

PHOTO (DETAIL):
RUŽA LEKO

Are we genetically predisposed to taking risks? Risk taking is linked to the hormone Dopamine. Recent research suggests that individuals that are genetically predisposed to a higher number of Dopamine receptors are more likely to take risks in a whole host of different scenarios from finance and health to drug taking and political beliefs. At **HUMAN+**, we will take saliva samples from human subjects to investigate the distribution of a particular allele in the Dopamine receptor D4. Should we engineer a society of risk taking adventurers or seek a balance between the risk loving and risk averse? Do we have any free will in determining the course we choose and the actions we take or is it all decided before we are born by our genetic make up? The results of this research will be analysed following **HUMAN+** and made available online at www.sciencegallery.com/humanplus



TALKING WITH ROBOTS

PROF NICK CAMPBELL
IRELAND

PHOTO (DETAIL):
RUŽA LEKO

This is your opportunity to have a chat with a robot. Developed as part of the FastNet project, an SFI funded initiative, this experiment will allow the visitor to interact with a robot and gain an insight into how a robot might interact with them. The focus of the experiment will be on the non-verbal aspects of conversation to show how humans process a myriad of signals from their gestures and tone of voice—this is something robots are not as good at processing. Using a LEGO NXT (Mindstorms) robot as a platform for cameras and microphones the work will offer the visitor a robot's-eye-view of a conversation with a human. The conversation data will be captured and used to create a collection of human-robot interaction, as well as a substantial database of voices and speech from Science Gallery visitors.

CREDITS

PROSTHETIC HEAD, STELARC
[WWW.STELARC.ORG](#)
IMAGES: BARRETT FOX, IGOR SKAFAR
MARCS Auditory Labs, University of Western Sydney The Thinking Head project is one of three Thinking Systems Special Initiatives jointly funded by the Australian Research Council (ARC), and the Australian National Health and Medical Research Council (NH&MRC), for the years 2007 to 2011. Stelarc's artwork is represented by the Scott Livesey Galleries, Melbourne.

THE HUMAN POLLINATION PROJECT, LAURA ALLCORN
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IMAGES: BUREAU
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School of Visual Arts, Pennsylvania State University

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IMAGES: JAMES JOHNSON
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School of Visual Arts, Pennsylvania State University

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Victoria University of Wellington, New Zealand
School of Visual Arts, Pennsylvania State University

AREA V5, LOUIS-PHILIPPE DEMERS
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SYTHETIC IMMUNE SYSTEM, TUUR VAN BALEN & JAMES CHAPPELL
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IMAGES: TUUR VAN BALEN
This project is developed as part of EPSRC's Impact! Exhibition at the Royal College of Art in collaboration with the Centre for Synthetic Biology and Innovation at Imperial College

COOK ME-BLACK BILE, TUUR VAN BALEN
[WWW.TUURVANBALEN.COM](#)
IMAGES: TUUR VAN BALEN
This project is commissioned by Z33 (Hasselt, Belgium) for the Alter Nature: The Unnatural Animal exhibition.

FREE WILL, DR AOIFE MCLYSAGHT, PROF LUKE O'NEILL, PROF HUGH GARAVAN, DR ROSS MCMANUS, PROF FIONA NEWELL, PROF KEN WOLFE, TRINITY COLLEGE DUBLIN
IMAGES: RUŽA LEKO

TALKING WITH ROBOTS, PROF NICK CAMPBELL
IMAGES: RUŽA LEKO
The exhibit is part of the SFI funded FastNet research project.

FORAGERS, ANTHONY DUNNE & FIONA RABY
[WWW.DUNNEANDRABY.CO.UK](#)
IMAGES: JASON EVANS, SYLVAIN DELEU, VIDEO: NICOLAS MYERS COMPUTER MODELLING: GRAEME FINDLAY, SOUND DESIGN: BERND HOPFENGÄRTNER
DESIGNS FOR AN OVERPOPULATED PLANET: FORAGERS, Commissioned by Design Indaba, South Africa, as part of Protofarm 2050 for the ICSID World Design Congress in Singapore, 2009
BETWEEN REALITY AND THE IMPOSSIBLE, Commissioned by Constance Rubini for the the 2010 St Etienne International Design Biennale, 2010.

CURATORIAL TEAM

DR JULIANA ADELMAN

Juliana Adelman is a research fellow at the Trinity Long Room Hub, Trinity College Dublin. Her research addresses the development of human ideas and intelligence as distinct from other animals.

DR RACHEL ARMSTRONG

Rachel Armstrong is an interdisciplinary researcher, medical doctor and science fiction author who is a leading authority on the modification of biological systems. Armstrong is a TED Senior Fellow and has engaged with the areas of extreme body modification and biotechnological intervention.

DR MICHAEL JOHN GORMAN

Michael John Gorman is the Founding Director of Science Gallery Trinity College Dublin. His publications include Buckminster Fuller: Designing for Mobility (Skira/Rizzoli, 2005), A Mysterious Masterpiece: The World of the Linder Gallery, with Lawrence Weschler and others Alias 2009, and many articles on aspects of the relationship between art and science in journals including Leonardo, Nature and Science.

DR AOIFE McLYSAGHT

Aoife McLysaght is the head of the genomics research lab at Trinity College Dublin and a Science Gallery Leonardo. McLysaght is an evolutionary geneticist, internationally recognised for her work in molecular evolution and the discovery of genes that are unique to humans.

DR ROSS McMANUS

Dr Ross McManus is the Director of Postgraduate education in Molecular Medicine in the Trinity School of Medicine, with a particular research interest in the genetics/genomics of common inherited diseases with an inflammatory component, particularly coeliac disease, psoriasis and sepsis and has been involved in the identification of many new susceptibility genes for these diseases.

PROF RICHARD REILLY

Richard Reilly is Professor of Neural Engineering at Trinity College Dublin. Reilly's work focuses on understanding and modelling the physiological basis for how we integrate and process sensory information from multiple sources, using leading-edge technologies for these diseases.

PROF CHARLES SPILLANE

Charles Spillane is a Professor of plant sciences at National University Ireland Galway. He leads a research group that study both fundamental and applied aspects of genetics and epigenetics in plant and animal systems. Spillane's work is advancing our understanding of molecular evolution and epigenetic inheritance.

ACKNOWLEDGMENTS

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TRINITY LONG ROOM HUB

The Trinity Long Room Hub is TCD's arts and humanities research institute. It was established in October 2007 and takes its name from the iconic eighteenth-century Library in Trinity. The Trinity Long Room Hub seeks to encourage and foster innovative interdisciplinary research across the entire spectrum of the arts and humanities at Trinity with a particular interest in stimulating research that will unlock the treasures of the College's incomparable Library, and in encouraging the application of new technologies to arts and humanities research.

TRINITY COLLEGE DUBLIN SCHOOL OF MEDICINE 1711-2011

For centuries, Trinity medics have contributed to medical education and practice around the world. William Stokes, Robert Graves, Denis Burkitt and other famous physicians were clinical researchers of their day. They made observations, they wrote them up, they published them, they treated their patients, and they taught their students. Today the School of Medicine preserves their legacy of preparing exceptional doctors who can lead the medical profession in the 21st century. The School undertakes it as its responsibility to ensure that excellence in education and research at Trinity has real impact on the lives of patients. In our School and teaching hospitals, with their public service ethos, we are extremely fortunate to have world-class doctors who are committed to making a difference. Trinity's discoveries in the area of immunology and how these might be applied in the treatment of poverty-related diseases constitute some of the most important medical research currently being undertaken anywhere in the world. Ground-breaking research in lung cancer and eczema published in premier league journals are other examples of research that will help improve and save the lives of many.

ABOUT SCIENCE GALLERY

Situated at the dynamic boundary between a leading research university, Trinity College Dublin, and a busy urban centre, Science Gallery is a new kind of hybrid space, bringing artists, scientists, designers and engineers into creative and critical dialogue through exhibitions, events and public experiments. Since opening in February 2008, more than 750,000 people have been engaged with Science Gallery's exhibitions, events and public experiments exploring themes ranging from the science of fashion to contagious laughter, crocheted coral reefs to living tissue as art. Science Gallery has received a number of awards for its work and continues to surprise at the dynamic intersections where science and art collide.

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HUMAN+
THE FUTURE OF OUR SPECIES

JULIANA ADELMAN,
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MICHAEL JOHN GORMAN,
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ROSS MCMANUS,
RICHARD REILLY,
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HUMAN+ COVER IMAGE

EMBRYO III BY STEVE BARRETT, USA. EMBRYO III IS THE RESULT OF THE ARTIST'S THINKING ABOUT THE FUTURE PROCESSES OF HUMAN GENETIC MODIFICATION.

STEVE BARRETT
USA

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